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Strategic use of ecosystem services and co-benefits for Sustainable Development Goals

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Abstract

Ecosystem services' (ES) assessments can inform sustainability policies but often translate poorly into practical decision-making due to their disconnection from local challenges. Problem framing is a crucial step in improving the operationalization of ecosystem studies. First, the study analyzes the challenges and opportunities for sustainability in three European outermost regions: the Canary Islands, French Guiana, and Reunion Island. Second, it proposes strategies to make use of ES assessments as a means to address these sustainability issues. We used a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis for strategic planning, extended with a PESTEL analysis, standing for Political, Economic, Socio-cultural, Technological, Environmental, Legal, and Regulatory. Semi-structured interviews ($n = 38$) were conducted to identify PESTEL factors facilitating or impeding sustainability in the case studies. Interviews were coded into PESTEL factors before being synthesized and reported into SWOT matrices. We suggest seven ESs implementation strategies addressing these challenges from these SWOT matrices. Finally, this paper highlights the potential contributions of ES-based strategies to achieving multiple United Nations' 2015 Sustainable Development Goals (SDGs). On average, the strategies are expected to affect the delivery of six ESs. The suggested strategies are expected to contribute to the achievement of SDGs 15 (Life on Land), 2 (Zero Hunger), 14 (Life Below Water), and 11 (Sustainable Cities and Communities). These results pinpoint the key factors to consider, through stakeholder consultation, when designing a practical ES study.

KEYWORDS
collaborative research design, qualitative data analysis, socio-ecological system, strategic decision-making, SWOT analysis

1 | INTRODUCTION

Demonstrating the indivisible link between Society and Nature is a key target of the young Sustainability Science (Kates, 2016). Ecosystems provide crucial resources and services—also known as Ecosystem Services (ESs)—that support our daily lives, such as food, timber, and energy. They protect us from floods and storms, regulate air and water quality, and provide for recreation (Haines-Young & Potschin, 2010). Nature degradation affects human well-being and the sustainability of our societies through losses in ESs. In 2005, the Millennium Ecosystem Assessment warned about the accelerating and potentially irreversible changes in ESs (Millennium Ecosystem

Assessment, 2005). Only with effective management of ecosystems and their services can we hope for a shift in these alarming trends (Geijzendorffer et al., 2017). Transformative changes (Sharpe et al., 2016) are necessary to promote more sustainable relationships between human society and ecosystems (Martinez-Harms et al., 2018).

In 2015, the United Nations defined 169 Targets grouped into 17 Goals to help achieve global sustainability by 2030. This global Agenda, entitled "Transforming Our World" (UN, 2015), provides a detailed roadmap for achieving the Sustainable Development Goals (SDGs). Since their release, the SDGs have been widely studied and sometimes criticized for serving discursive political purposes rather than transformative ones (Biermann et al., 2022), for reflecting dominant liberal worldviews (de Vries, 2019), and failing to tackle the roots of unsustainability (Henfrey et al., 2022). There has been however little evidence of the SDGs' potential to curve degradations. Indeed, in 2019 the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) global assessment stresses the persisting trends in biodiversity and ecosystem function decline (IPBES, 2019). The SDGs are not being achieved (IPBES, 2019; Sachs et al., 2022; UN, 2019); worse, some trends seem to be moving toward their tipping points (UN, 2019). Inequalities (SDG 10), waste production (SDG 12), climate changes (SDG 13), and biodiversity losses (SDG 15) are still rising. Nevertheless, the 2030 Agenda established a much-needed common language on sustainability, fostering dialogue across different sectors and stakeholders (Nilsson et al., 2016).

Managing and monitoring ecosystems and their services is critical for achieving the SDGs (Balvanera et al., 2022). Indeed, the protection and restoration of ecosystems and their services are embedded in the SDGs (UN, 2015). ESs and SDGs share similar integrated views on sustainability and social-ecological systems approach (Johnson et al., 2019). A total of 12 SDGs are strongly supported by the supply of ESs (Wood et al., 2018), making ESs and SDGs highly interconnected. According to Wood et al. (2018), the SDGs relying most on ESs are in order of importance SDG 15 (Life on Land), 14 (Life Below Water), 1 (No Poverty), 11 (Sustainable Cities and Communities), and 3 (Good Health and Well-being). However, co-benefits generated from ES-based management for SDGs implementation are often overlooked and underexploited (Yang et al., 2020).

Considering the political weight of SDGs (Biermann et al., 2022; Henfrey et al., 2022), linking ESs assessments with SDGs could help communicate about ESs. The ESs jargon is somewhat complex for those unfamiliar with these approaches (Longato et al., 2021). Moreover, in the ESs field, science, policy, and practice are often shown to be disconnected from each other due to studies abstracting real-world problems (Jax et al., 2018; Nahuelhual et al., 2020). Evidence of ESs assessments' practical implementation in support of policy and decision-making remains scarce (Bitoun et al., 2022; Longato et al., 2021). If research on ESs is to find a helpful translation, more studies should be grounded in local issues, provide transparent objectives, and engage stakeholders collaboratively throughout the research process (Martinez-Harms et al., 2018). Engaging multiple actors at the local level could benefit sustainability achievement (Geijzendorffer et al., 2017). However, very few ESs studies set their objectives through stakeholder consultation, and even fewer report on actions implemented on the ground (Martinez-Harms et al., 2015). Problem formulation should be a key concern when designing a useful ES study.

Therefore, this study aims to provide a view of some enablers and barriers to achieving sustainability in three outermost European Union (EU) regions: the Canary Islands, French Guiana, and Reunion Island. We argue that a territorial sustainability diagnosis can help design strategic and useful ES studies. We assessed this research question by reviewing context-specific factors such as, but not limited to, management practices, cooperation among stakeholders, environmental threats, and economic development. This question was investigated using semi-structured interviews in the three study sites to collect evidence of the main Strengths, Weaknesses, Opportunities, and Threats (SWOT analysis), challenging, or facilitating sustainability. Our study will investigate how a SWOT analysis can provide an appraisal for strategic ESs study framing. Finally, we demonstrate how implementing the strategies can affect the delivery of multiple ESs and simultaneously advance SDG achievement.

2 | MATERIALS AND METHODS

2.1 | Site description

This study was conducted in the context of the European MOVE-ON project (https://moveon-project.eu/), a project studying the adoption of ES policies in EU overseas territories. The MAES barometer (Burkhard et al., 2018), a monitoring tool assessing the level of ESs implementation in each region, informed our case study selection. We selected the sites with the highest score on a 25-point scale (French Guiana, 16 points) and the lowest (Reunion Island, 6, and the Canary Islands, 7) to explore contrasting case studies.

The Canary Islands are a North Atlantic volcanic archipelago located off the Southwest of Morocco, consisting of eight islands. The Canary Islands' governance is embedded in a complex, multilayered system comprising the Spanish national level, the Autonomous region level, two provincial governments, and an elected Island Council on each island. Tourism steers the local economy and improves local economic conditions (Antonova et al., 2021) but has caused considerable environmental impacts.

French Guiana and Reunion Island are French overseas territories. French Guiana is located in northeastern South America, bordering Brazil to the South and Suriname to the West. In contrast, Reunion Island is located East of Madagascar in the Indian Ocean.

French Guiana hosts abundant biodiversity, with seven to 10,000 plant species (De Geyer et al., 2020). Small-scale gold mining (Hammond et al., 2007) and urbanization are the two main drivers of environmental change. Most of the population occupies 10% of the territory along the coastal areas. However, urbanization pressure is expected to increase as projections estimate that the population will double by 2050 (Demougeot & Baert, 2019). The French Guianese economy is steered by its space center. Secondary economic sectors include timber production, fishing, and construction.

Reunion is a tropical volcanic island, internationally recognized as a biodiversity hotspot due to significant endemic species rates (28% of species endemic to the island, 45% are endemic to the Mascarene archipelago; Saliman et al., 2017). Reunion National Park covers 40% of the island. Nevertheless, invasive alien species threaten the island's biodiversity (Strasberg et al., 2005), exacerbated by the intense tourism. Both French Guiana and Reunion Island's populations are affected by high unemployment rates, aggravated by poor levels of school enrolment.

2.2 | Conceptualization and interview structuring

Stakeholder interviews were conducted in the field and organized using SWOT analysis, a well-known tool listing internal and external strengths and weaknesses as a starting point for strategic planning (Helms & Nixon, 2010). SWOT analysis is widely applied in business management to support strategic decision-making. Still, it has been used for environmental management, specifically ESs approach implementation. Previous studies used SWOT analysis to assess the ESs framework itself (Bull et al., 2016) or to assess the opportunities for integrating ESs into existing policy documents (e.g., Atumane & Cabral, 2021; Inkoom et al., 2017). Moreover, SWOT analysis can help target priorities for sustainable development grounded on stakeholders' knowledge (Gkoltsiou & Mougiakou, 2021). We followed the SWOT factor definitions of Jetoo and Lahtinen (2021), adapted to the context of SDGs. Strengths and Weaknesses are, respectively, a territory's internal features facilitating or impeding SDG achievement. Opportunities and Threats are external features that affect the territory and the achievement of SDGs. For example, we regarded political interest and biodiversity as internal features while considering climate change and EU regulations as external features.

A literature review on ESs and SWOT analysis was performed. Nine papers studying ESs using SWOT analysis were identified (see Supplementary Materials A1). SWOT factors were extracted from the literature and organized into PESTEL categories (Figure 1). For example, Bull et al. (2016) argue that "interest of societal actors" constitutes an opportunity for ES concept application. In contrast, Arsić et al. (2018) consider low environmental awareness as a weakness for the uptake of ESs-based management. Therefore, 'Environmental Awareness' and 'Socio-economic Status' that comprise education levels are classified into Socio-Cultural factors for the analysis.

The pre-identification of factors provided a theoretical basis for elaborating the semi-structured interviews. The interview template (Supplementary Materials A2) was used as a guideline for face-to-face meetings with selected stakeholders to collect local knowledge on these pre-identified factors, such as economic activities, environmental health and management, and data availability. Then, the content of the interviews determined whether a factor is positive (strength or opportunity), negative (weakness or threat), or irrelevant to the case study. Additional questions were asked during the interview about other potential factors affecting sustainability, accordingly to the area of expertise of the stakeholder.

2.3 | Data collection

The data collection and analysis follow the framework presented in Figure 2. Purposeful sampling (Miles et al., 2019) was used to select individuals knowledgeable about our topics of interest. Participants were selected from three sources. First, stakeholders were selected from the databases developed in the MOVE-ON project (MOVE-ON, 2021). Stakeholders working on topics related to ESs (e.g., natural sciences,

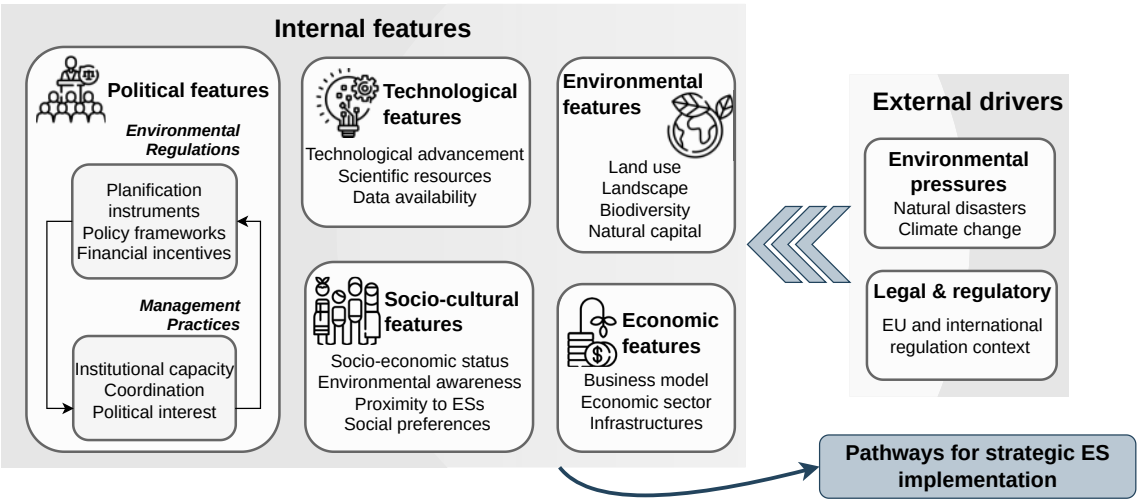

FIGURE 1 Pre-identified factors for the proposal of strategic ecosystem services (ES) assessments. These factors are based on the literature review ($n = 9$) of features to consider for strategic pathways for ES implementation. Depending on the case study, these features constitute strengths, weaknesses, opportunities, or threats, affecting sustainability and ES delivery. External drivers affect internal features, which must be considered as a whole for the design of relevant ES studies. This figure has been designed using infographic resources from "Freepik" on Flaticon.com. [Colour figure can be viewed at wileyonlinelibrary.com]

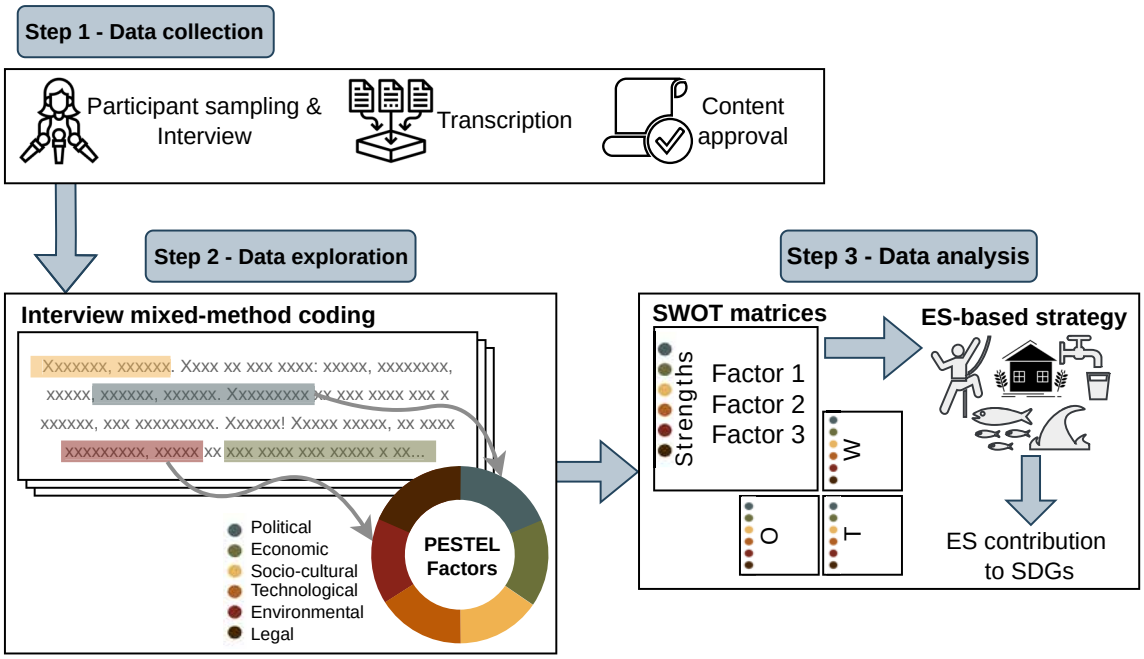

FIGURE 2 Workflow display for the proposal of strategies for achieving Sustainable Development Goals (SDGs) using Ecosystem Services (ES) approaches. These proposals are based on the Political, Economic, Socio-cultural, Technological, Environmental, and Legal (PESTEL) Strengths, Weaknesses, Opportunities, and Threats (SWOT) analyzed in three EU outermost regions (the Canary Islands, French Guiana, and Reunion Island). This figure has been designed using infographic resources from "Freepik" on Flaticon.com. [Colour figure can be viewed at wileyonlinelibrary.com]

spatial planning, ecological economics) were favored, following Bull et al. (2016). Second, a complementary Web search was performed to improve the sample's representativeness (e.g., number of participants per case study, type of organizations, and the sector). Finally, snowball sampling (Goodman, 1961) was used to reach additional individuals. Each participant in the study was asked to provide contact information of individuals they believed to influence local environmental management or are knowledgeable of our topics of interest. The target groups consisted of local and regional administrations, private organizations, non-governmental organizations, local representatives, nature protection associations, and experts from universities. As Miles et al. (2019) recommended, our goal was to reach information saturation, a concept defined as obtaining a comprehensive understanding of a topic until no new substantive information is acquired. We considered data saturation reached when the number of unique codes (themes) decreased with the number of interviews. A triangulation of the qualitative data sources (Patton, 1999) aimed at cross-validating the consistency of the information collected during the interviews. For example, when conflicting ideas emerged, we asked other participants their opinion on the topic. Different sources of data were collected as a means for comparison. Primary sources of qualitative data used for the analysis included observations, field notes, documents specific to the case study sites provided by participants (e.g., brochures, reports, and mental maps drawn by interviewees), scientific papers, and the interview transcriptions, corrected and commented on by the participants.

Participants gave formal written consent to write transcriptions of the interviews for further analysis of their content. Complete transcriptions were sent back to participants for content approval. To preserve participant confidentiality, their names were anonymized. Data management followed the ethics guiding principles of the author's research institution in respect of the European framework on data management (General Data Protection Regulation 2016/679). Participants were granted rights to access their data, rectify their statements, delete their statements, and limit the use of their statements.

2.4 | Data exploration

One of the shortcomings of SWOT analysis is its subjectivity, which can lead to inconsistencies and omissions (Helms & Nixon, 2010). Building on lessons from Panagiotou and van Wijnen (2005), the SWOT framework was complemented by the strategic analysis method Political, Economic, Social, Technological, Environmental, and Legal (PESTEL) and regulatory (Sammut-Bonnici & Galea, 2015). PESTEL analysis is a strategic framework used to analyze and monitor a system's macro-environment (Øivind Madesn & Ove Grønseth, 2022). Combining SWOT and PESTEL to study ES is useful and novel, helping ensure a more systematic and comprehensive reporting of the critical factors for sustainability.

Consistently with Miles et al. (2019), qualitative data were condensed into case summaries and coded into themes. Interview coding was initiated from a first codebook generated by an automatic theme coding of interviews. Qualitative data was explored and analyzed with

NVivo 1.6.1. QSR International. Automatic codes were then condensed and organized into PESTEL categories and sub-categories, enriching the first themes selected in Section 2.2. (First coding cycle). Successive iterations through the content of the interviews allowed for the extension and the adaptation of the initial codebook to each case study (second coding cycle). Mixed-method coding was used based on three coding methods: descriptive coding, In Vivo coding (Saldaña, 2015), and theme coding (Miles et al., 2019). A third coding cycle verified that codes had been consistently attributed within the datasets. Finally, the authors and co-authors reviewed the qualitative dataset to compare the findings. This analyst triangulation (Patton, 1999) aimed to limit potential biases when interpreting the data.

Challenges and opportunities for the implementation of ESs were assessed using thematic analysis. PESTEL categories were separated into the four SWOT categories and synthesized into matrices where the categories were ranked based on the occurrence of each factor (Bull et al., 2016). As the method combines SWOT and PESTEL analysis, the matrices present 24 quadrants instead of the classic four-quadrant analysis. Each row of the matrix corresponds to a PESTEL factor (6 rows), and columns correspond to the four SWOT factors. The PESTEL rows are organized following the distribution of the codes within the dataset, with the first row corresponding to the most representative PESTEL factor. Likewise, subfactors (e.g., "Institutional Capacity" and "Climate change") are ordered into the matrix's cells according to their occurrence and SWOT type. For example, "Institutional Capacity" is an internal feature that can hence either be a strength or a weakness, depending on the case study, while "Climate Change" is an external feature that can either be an opportunity or a threat.

2.5 | Data analysis

Based on the SWOT matrices and the ranking of factors, we suggested ESs-based strategies that could address local issues challenging the achievement of sustainable development. These strategies aimed to provide the potential for strategic use of ESs approaches, which could optimize strengths, seize opportunities, and overcome weaknesses and threats. The contributions of these ES-based strategies to specific ESs were assessed against the standards of The Common International Classification of Ecosystem Services, CICES v5.1 (Haines-Young & Potschin-Young, 2018; www.cices.eu). The ESs-based strategies were considered to contribute to an ES if a positive impact on the supply of a given ES was expected from the strategy's implementation. For example, the protection of a river catchment is likely to preserve ESs related to water resources.

To link ESs to SDGs, we used the survey results from Wood et al. (2018), who analyzed the perceived level of ES contribution to SDGs using expert opinion. The SDGs selected in their study were those having an impact on human well-being or those having an environmental outcome. Therefore, SDGs dealing exclusively with policy outcomes were excluded as their connections to ESs were uncertain. A Sankey diagram was produced in Python (Pycharm C.E. 2021.3.2., https://blog.jetbrains.com/pycharm/) using the Plotly open-source graphing library (Inc., P. T., 2015) to link the contribution of ESs to the achievement of SDGs.

3 | RESULTS

3.1 | Interviewee characteristics

A total of 39 participants were interviewed between June and December 2021 in the Canary Islands ($n = 10$), French Guiana (19), and Reunion Island (10). The interview duration averaged an hour and forty minutes, ranging from one to three hours.

Interviewees represent diverse types of stakeholders, dominated by "Academics" (25%), followed by "NGOs" and nature protection associations (22%), "Public agencies" (21%), "Private Organizations" (17%), and "Administrations" (15%). However, the proportion of stakeholder types varied amongst study sites. NGOs and nature protection associations were not represented in the Canary Islands. A low response rate in this study site (17.5%) prevented a more diverse range of interviewees. French Guiana's sample represents all types of stakeholders, with a dominance of public agencies (39%). The positive response rate reached 41.9%. Finally, the Reunion Island sample is more evenly distributed, except for NGOs representing 43% of the sample. The positive response rate reached 35.7%.

3.2 | PESTEL factors and SWOT analysis

The distribution of Level 1 PESTEL factors, identified through the coding process, is presented in Figure 3. Similarities and differences are observed from the analysis of their distribution.

In the case studies, the hierarchy of factors follows similar patterns, with a dominant group comprising "Environmental" (average of 31.3%, ranging from 25% to 40%) and "Political" (29.7%, [22%–44%]) factors, followed by a second group comprised of "Socio-cultural" (11.3%, [11%–15%]), "Economic" (10.7%, [6%–18%]), and "Technological" (9.7%, [9%–10%]) factors. "Legal and Regulatory" factors represent a minor share in all case studies, averaging 5.3% ([5%–6%]). The main PESTEL subfactors, identified in the preliminary literature search and enriched during the coding process, are displayed in detail as sunburst charts per case study in Supplementary Materials B.

In the following section, we present the Canary Islands results to provide an illustrative example of the results after analysis. The charts and SWOT matrices of French Guiana, Reunion Island, and the full Canary Islands SWOT matrix are available in Supplementary Materials C. The Canary Island principal codes are presented in Figure 4. Charts are structured into three rings, following the codebooks used for analysis (e.g., environmental factors [level 1] > biodiversity [level 2] > fauna [level 3]). Interviews from the Canary Islands highlight a dominance of the environmental factors, followed by political and economic factors, as sources of hindrances or

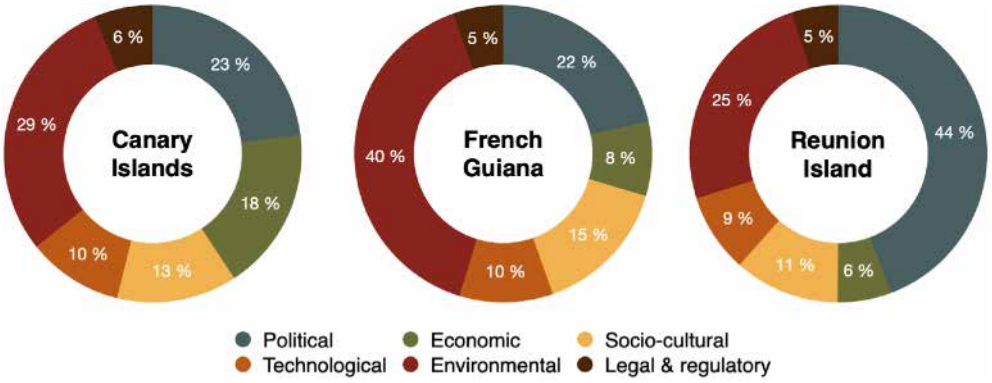

FIGURE 3 Distribution of the PESTEL factors per case study (the Canary Islands, French Guiana, and Reunion Island). [Colour figure can be viewed at wileyonlinelibrary.com]

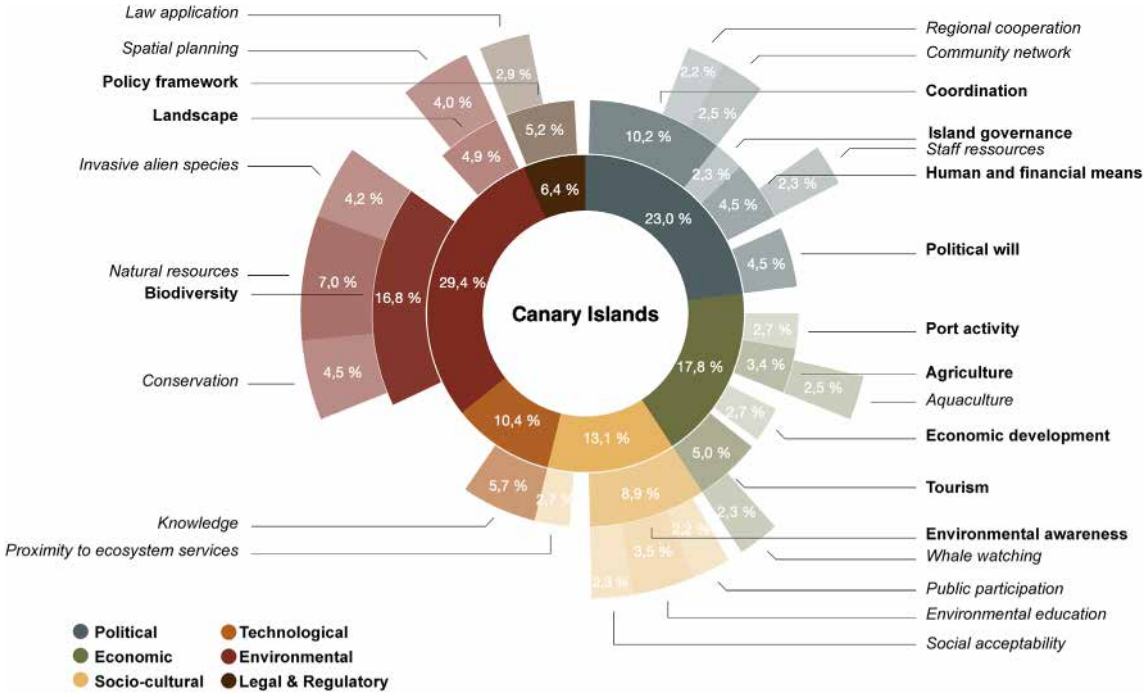

FIGURE 4 PESTEL factors and subfactors most representative of the Canary Islands. In bold level 2 factors, in italics level 3 factors. The results from the other case studies (French Guiana and Reunion Island) are available in Supplementary Materials B. [Colour figure can be viewed at wileyonlinelibrary.com]

opportunities to achieve sustainable development (Figure 4). The most representative environmental subfactors were natural resources, conservation, and invasive alien species. Political subfactors highlight the importance of political will, human and financial means, and island governance, whereas economic subfactors comprise aquaculture, port activity, and tourism.

Table 1 displays an extract of the Canary Island SWOT matrix following the PESTEL distribution presented in Figure 3. Thus, for the Canary Islands, the first row is 'Environmental' (29%), and the second is 'Political' (23%). Likewise, subfactors presented in Figure 4 (e.g., "Knowledge" or "Tourism") are organized into the SWOT matrix cells according to their occurrence (respectively, 5.7% and 5.0%). Amongst the main factors identified across all four SWOT categories, the sound management of natural resources, cooperation amongst islands, political interest in the Blue Economy, and tourism are highlighted as the most important strengths of the Canary Islands. However, marine economic activities (e.g., port industry, offshore oil rigs, and ferry navigation) threatened the sustainability of marine ecosystems and biodiversity. The full matrix's content is available in Supplementary Materials C1.

Results for French Guiana also suggest the dominance of environmental factors, followed by political and socio-cultural factors (Supplementary Materials B, Figures B1 and B2). Forest conversion and mineral resources are essential environmental subfactors, while partnership and political will are critical political subfactors. Amongst the key factors identified in the SWOT matrix, the abundant natural resources and biodiversity are the most important environmental strengths of French Guiana, followed closely by technological strengths, such as good funding for research programs and a solid commitment to technological innovation. However, a list of 18 factors

TABLE 1 Extract of the Canary Island SWOT matrix.

	Strengths	Weaknesses	Opportunities	Threats
Environmental	*Biodiversity*: Many natural protected areas. *Conservation*: Forest and water resource management accredited with the FSC certification for good forestry practices. Strong collaboration in the direction of protected areas. *IAS*: Possesses one of Europe's largest seed banks and ensures management of plant nurseries consistent with genetic variability. *Spatial planning*: Pioneers in marine spatial planning.	*Biodiversity*: The forest covers have greatly suffered from intensive agricultural practices and intensive use of natural resources. The forest covers are now relictual, scattered over the islands with little connectivity. *Conservation*: Conflicting economic, political, and social dimensions. Conflicting with scientific and environmental evidence. *IAS*: Although local representatives use endemic species for plantation in urban areas and parks, they have little consideration of the genetic origin of species despite the available information on genetic analysis. *Spatial planning*: Port construction projects are contradictory to the protection of nature. Rising demographics cause further land artificialization, especially in the coastal area.	*Conservation*: National Park project underway. Strong will to include local natural resource users in the park's creation to preserve livelihoods. Likely to foster good social acceptance. *IAS*: Bioproduct extraction from invasive species is under exploration.	*Biodiversity*: Port infrastructures, offshore oil rigs, and climate changes disturb the trophic chain. This is pressuring the marine mammal populations, relying on coastal fish stocks for survival. *IAS*: Highly threatened (overgrazing, losses of seed disseminator species). *Natural resources*: Water resources, although currently sufficient, remain scarce on the islands.
Political	*Island governance*: Diverse archipelago where islands have their own identity. The government has progressively delegated natural area competencies to the island level—good island collaboration in managing protected areas. Island administrations join their teams to work together on programs. *Political will*: Strong influence of political will on specific topics (e.g., Blue Economy). *Financial*: Sufficient funding. *Regional cooperation*: Strong regional collaboration with states from the Macaronesian region and global export of their aquaculture practices. Cooperation is fostered through exchanges of skills and student training.	*Coordination*: Despite the excellent knowledge of ecosystems and the threats they undergo, communication channels do not ensure the adequate flow of information to decision-makers and the population. *Political will*: Lack of political will on fauna, flora, and waste management, especially tourism. *Community network*: Few NGOs dealing with natural resources exist. Participants find the work of forest associations sometimes harmful due to a lack of scientific basis for their practice. *Island governance*: Variability in the institutional capacity of islands. More staff and financial resources in the highly populated islands.	*Political will*: A change of political party in the last regional election led to a shift of focus of the regional representative, who is more sensitive to climate change mitigation, Blue Economy, and waste management. *Financial*: The creation of a financial and environmental tax for fuel-based resources is under analysis. This tax is intended to finance forest restoration.	

(Continues)

TABLE 1 (Continued)

Strengths	Weaknesses	Opportunities	Threats
	Staff resources: Increasingly limited since the 2008 economic crisis, where the Spanish Government has cut down public expenditures. Retired workers are no longer replaced.		

TABLE 2 Summary of the potential ESs implementation strategies for sustainability achievement, based on the analysis of the SWOT matrices per case study.

Strategy	Short name	Description	Type of assessment	Objective	Method name
CI.S1	Ferry regulations	Assess tourist willingness to pay marine mammal conservation to compensate ferry operators for an economic loss caused by speed reduction.	Economic	Reputational and Marketing	Contingent valuation
CI.S2	Protected areas	Increase a protected area's social acceptability by engaging stakeholders.	Socio-cultural	Priority setting	Deliberative assessment
CI.S3	Aquaculture	Monitor the positive and negative effects of fish farms on ESs.	Economic	Project evaluation	Corporate ES review
FG.S1	Flood mitigation	Raise awareness of the location of ES hotspots and the economic consequences of neglecting regulating services such as water buffering.	Economic	Project evaluation	Damage cost avoided
FG.S2	Land use optimization	Guide decision-makers in identifying priority areas for land use planning to preserve ecological connections and ESs delivery.	Biophysical	Priority setting	Integrated modeling framework
RE.S1	Ecological baseline for restoration	Set a baseline for ecological restoration to identify which sites could be successfully restored.	Biophysical	Priority setting	Integrated modeling framework
RE.S2	Invasive alien species	Temporal analysis for the analysis of ecosystem services trajectories about biological invasion processes.	Biophysical	Awareness-raising	State and transition model (STM)

within the weakness category reflects the negative outlook of respondents on the potential for sustainable development. Gold mining, forest conversion, and high turnover rates in staff resources are the top three threats.

The Reunion Island data highlight a dominance of political factors, followed by environmental factors (Supplementary Materials B, Figures B1 and B3). Political subfactors suggest various political issues, such as overlapping jurisdictions and communication issues with elected representatives. The main environmental subfactors are invasive alien species, conservation, and timber production. The SWOT results suggest the dominance of political weaknesses as a source of an impediment to achieving SDGs within the territory (e.g., complex partnership amongst environmental actors, a low political priority of environmental topics). Invasive alien species were identified as a significant threat to Reunion Island.

3.3 | Ecosystem services contribution to SDGs

Based on the outcomes of the SWOT analyses for each case study, seven strategies for implementing ESs-assessments are suggested (Table 2). The SWOT factors are ranked based on coded references (Supplementary Materials C1). Table 2 summarizes a brief description of the ESs strategies, their goal, the type of ESs assessment necessary for their implementation (i.e., biophysical, economic, or socio-cultural), and a suggestion of suitable methods. A detailed description of each strategy is provided in Supplementary Materials C2.

The strategies cover multiple ESs (Table 3). From the CICES v5.1 ES classification, we identified which ESs would be positively impacted by implementing the strategies. On average, the strategies are expected to affect the delivery of six ESs. A minimum of four ESs are involved with the "Ecological baseline" strategy for Reunion Island

TABLE 3 Contribution of the ESs-based strategies to the supply of ESs, based on the CICES v5.1 classification system of ESs.

Ecosystem service (ES) division	Simplified ES name	CI.S1	CI.S2	CI.S3	GF.S1	GF.S2	RE.S1	RE.S2
Biomass	Food provision		x[a]	x		x		
	Raw materials		x	x		x		
Genetic material	Genetic resources (incl. medicinal)		x	x		x	x	x
Mediation of wastes of anthropogenic origin	Waste treatment	x		x		x		
Regulation of baseline flows and extreme events	Erosion control				x	x		
	Water flow regulation				x	x		
Lifecycle maintenance, habitat and gene pool protection	Pollination, seed dispersal		x			x	x	x
	Habitat maintenance	x	x		x	x	x	x
Pest and disease control	Pest and disease control		x				x	x
Water conditions	Water quality	x		x	x	x		
Atmospheric composition and conditions	Air quality	x			x	x		
	Carbon storage and sequestration							
Physical and experiential interactions with the environment	Recreation and tourism	x	x					x
Water	Water provision					x		

[a]"x" if the strategy positively affects an ecosystem service supply, blank if there is no expected effect.

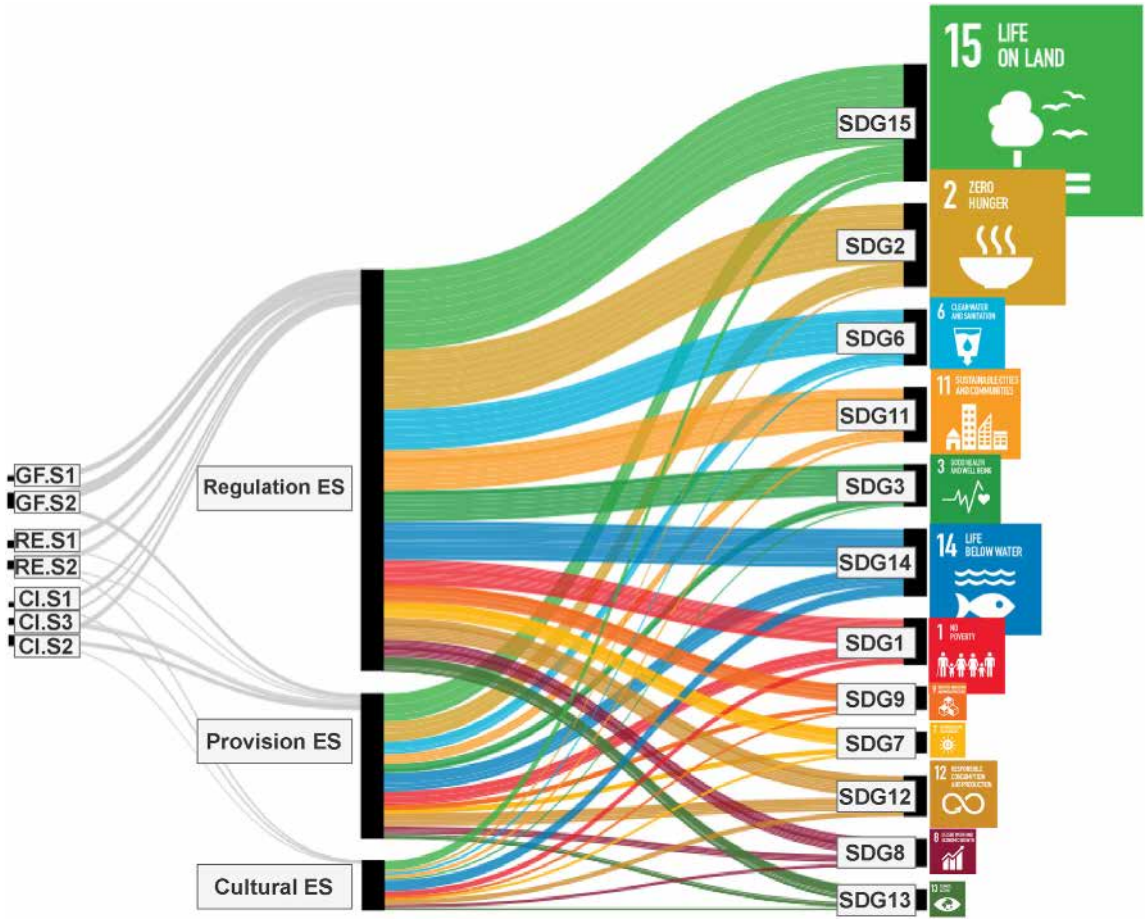

FIGURE 5 Contributions of strategies for ecosystem services (ES) implementation (on the left) in the Canary Islands (CI), French Guiana (GF), and Reunion Island (RE) to the United Nations Sustainable Development Goals (SDG, on the right). Links between ES and SDGs are adapted from Wood et al. (2018). The size of the icons is proportional to the strength of ES contribution to a given SDG. [Colour figure can be viewed at wileyonlinelibrary.com]

(RE.S1) and a maximum of 11 ESs with the "Land use optimization" strategy for French Guiana (GF.S2). The most affected ESs amongst the seven study site strategies was "Habitat maintenance" ($n = 6$) and "Genetic resources" ($n = 5$). Strategies contribute mainly to "Regulation ESs" (Figure 5), then to a lesser extent to "Provision ESs," while "Cultural ESs" remain poorly addressed. Indeed, these strategies are expected to affect only "Recreation and Tourism."

Our results show multiple interlinkages and the effects of the strategies on achieving multiple SDGs (Figure 5). There is a substantial contribution to SDGs 15 (Life on Land), 2 (Zero Hunger), 14 (Life Below Water), and 11 (Sustainable Cities and Communities). To a lesser extent, these strategies also contribute to SDGs 1 (No Poverty), 6 (Clean Water and Sanitation), and 12 (Responsible Consumption and Production).

4 | DISCUSSION

4.1 | A rapid appraisal of local enablers and barriers to sustainability

Challenges disconnecting science, policy, and practice in ESs is an ongoing issue (e.g., Daily & Matson, 2008; Lautenbach et al., 2019). A shortcoming of ES studies is their poor relation to real-world problem-solving (Chen et al., 2019; Jax et al., 2018). This leads to the limited potential of ESs studies to tackle institutions' needs and interests. When designing ES studies, careful attention should be provided to the definition of the problem to solve (Jax et al., 2018). Lautenbach et al. (2019) stress the usefulness of including stakeholder knowledge in the design of ES studies. They argue that stakeholders provide comprehensive information regarding a given issue or a specific resource. However, participatory approaches remain highly time-consuming, although helpful in fostering social learning (Cowling et al., 2008). Therefore, there is a need for a rationale, a rapid appraisal method for the design of ESs studies that can effectively address practitioners' questions.

The specificity of our case studies is their remoteness due to their insularity and the somewhat landlocked feature of French Guiana. Islands and other remote territories share common challenges in natural resource management and governance issues, which limit the potential for the success of environmental protection and sustainability policies. Our results show that political factors constitute enablers in the Canary Islands and barriers in Reunion Island and, to a lesser extent, in French Guiana. Hindrances for "Coordination" (political subfactor) were identified in Reunion Island due to the absence of strong leadership and a lack of guiding and coordinating efforts toward a common strategy. However, the interviews were conducted shortly after the regional elections, resulting in a change of political colors. These events could provide a partial explanation for the high weight of political factors at the time of the study. In French Guiana, political issues related to the lack of vision of what had been done in the past and high turnover rates affect the capacity for long-term strategic planning. Similarly, other studies point out the importance of political factors in the uptake of ESs, such as power relationships (Martinez-Harms et al., 2018), modes of governance, competing interests, political agendas, and vertical and horizontal organization (Saarikoski et al., 2018).

Social-cultural and economic features can also set barriers to sustainability achievement, even more so on islands. Because culture is relatively stable (Reverte, 2022), programs promoting sustainability should be consistent with local customs. Douglas (2006) stresses that sustainability concepts rely on the assumption often proved incorrect of "societal consensus on resource utilization, management issues, and the causes of environmental problems." Our case studies exemplify the social consensus dilemma that generates tensions and division amongst stakeholders. Environmental protection is qualified as "white men's problems" in French Guiana. Environmental measures conflict with traditional and historical uses of natural assets on Reunion Island. Finally, there is a great divide between environmental managers and public opinion on invasive grazer management in the Canary Islands. However, despite the local debate on invasive alien species management in the Canary Islands, tourists' demands for well-managed ecosystems pressure decision-makers in their environmental planning (Supplementary Materials C).

Building on the qualitative analysis we carried out in three EU outermost regions, we suggest taking into consideration local issues on PESTEL factors when framing an ESs study. If ESs uptake is poor in a region, one should consider key factors hindering sustainability, not limited to environmental issues. Environmental factors only constitute a fraction of the definition of sustainability and, if studied as a stand-alone component, may rule out economic, political, or social issues that influence a territory's relationships to nature. However, in all case studies, technological and legal factors accounted for minor shares and were evenly distributed amongst case studies (on average, 9.7% and 5.3%, respectively). Therefore, PESTEL analysis could be narrowed to its Political, Economic, Socio-cultural, and Environmental (PESE) components to address sustainability challenges.

4.2 | The role of ESs in sustainability achievement

Given this research's limited number of case studies, it remains challenging to define generalizable conclusions. However, three major topics stand out from the SWOT analysis of strategic ESs assessment for sustainability: priority setting for spatial planning; invasive alien species management; and, aquaculture in the Canary Islands.

Priority-setting objectives for ES assessment were the most representative objective in our case studies (three of the seven strategies, Table 2). Indeed, all case studies faced urban planning challenges leading to anarchic urban sprawl and increased land artificialization. ESs assessments can help steer and manage urban development to improve living conditions while minimizing environmental and socio-economic impacts (Grunewald et al., 2021). Moreover, if local representatives have little knowledge of the role of ecosystems, ES assessment should favor topics that match political agendas to convey

critical messages to safeguard the environment. Utilitarian arguments can be compelling in convincing governments of the merits of protecting certain areas from development (Reid et al., 2006). For example, in French Guiana, unmanaged spatial planning damaged the wetlands' flood buffering role. Assessing the economic value of flood protection could be effective in shifting current development practices. Tangible applications for ESs in urban planning involve identifying green infrastructure networks and zoning ES hotspots and coldspots. Other methods, such as Multi-Criteria Analysis (MCA), are useful for priority setting. MCA aims to compare alternative planning scenario and their impact on ESs to inform strategic decision-making on urban development (Cortinovis et al., 2021).

Lower land artificialization coincided with higher implementation levels and awareness of ESs concepts. Indeed, French Guiana is vastly covered in Amazonian forest and demonstrates the highest level of ES use according to the MAES barometer. The Canary Islands, and even less Reunion Island, score poorly on the barometer and are both faced with critical threats to biodiversity, primarily due to high rates of biological invasions. Invasive Alien Species (IAS) was a major topic in these two territories, but also in French Guiana, where interviewees were alarmed about the risk of poor land management and savannah loss on the increase in invasions. The Convention on Biological Diversity aims to control or eradicate priority species and manage pathways preventing new introductions by 2020. This ambitious goal is not reached. Roman and Mauerhofer (2022) suggest awareness plays a huge role in IAS management, along with high cooperation and coordination between the stakeholders, which all our case studies seem to lack. Thus three of the seven ES strategies link directly or indirectly to IAS management. Introduced species are both "a blessing and a curse" (Pejchar & Mooney, 2009) as they can have both beneficial and detrimental effects on ESs. However, IAS's impact on ESs is poorly understood, and it remains unclear how to assess ESs in highly modified landscapes.

Finally, aquaculture was a critical topic in one of the three case studies. According to interviewees, the Canary Islands are an international reference for finfish aquaculture. Intense collaboration between researchers and industries fosters innovation and good practices. There has been a recent academic interest in studying aquaculture systems ESs (Weitzman, 2019). The most common methods for aquaculture ES studies are economic valuations such as replacement cost analysis, direct market value, and production functions. These assessments could help assess positive or negative aquaculture impacts on ESs, such as erosion control, biodiversity, and carbon sequestration. Nevertheless, marine finfish aquaculture ES assessments are underrepresented despite their potential environmental impacts (ibid.).

4.3 | Cumulative effects of SDGs and synergies with other policy frameworks

ESs-based approaches can account for the complexity of social-ecological systems and the interactions within these systems, consistently with the SDG ambitions (Johnson et al., 2019). Our results suggest that mapping, assessing, and managing ESs could contribute to multiple SDGs beyond the sole sphere of biodiversity. Indeed, the proposed ESs-based strategies are expected to contribute to conservation-related SDGs (15 and 14) and to generate co-benefits on social-related SDGs such as those dealing with food security (SDG 2), sustainable cities (SDG 11), water resources (SDG 6), and production systems (SDG 12). Consistently with our results, Erdogan et al. (2021) found many SDGs directly considering ESs, such as SDGs 1 (No Poverty), 2 (Zero Hunger), 6 (Clean Water and Sanitation), 11 (urban development), 12 (consumption and production pattern), 13 (climate), 14 (land-based nutrient pollution of the seas), and 15 (terrestrial ES sustainability).

Assessing ESs' contribution to SDGs can serve as a basis for identifying synergies with other sectoral policy frameworks. Although EU policies are not directly coordinated with SDGs, SDGs link virtually to all EU policies (Steurer, 2021). These linkages were translated into a European Commission report on the actions supporting the 2030 Agenda and the SDGs (EC, 2016). In the past couple of years, EU policy changes tackled social, economic, and environmental sustainability with comprehensive frameworks consistent with the SDGs. For example, the European Green Deal (EC, 2019) addresses 12 out of 17 SDGs. Moreover, the European Commission is committed to monitoring the implementation of Agenda 2030 through Eurostats' yearly tracking of EU progress (Kluza et al., 2021). Therefore, through their link to SDGs, in which ESs are firmly embedded, ESs could indirectly achieve simultaneously multiple international, European, national, and local policy targets. We believe these strong policy synergies could help ESs assessments find a quick translation into decision-making.

Decisions based on the preservation of multiple ESs could help balance short-term strategies maximizing provision services (e.g., food provision and timber) with the necessary long-term sustainability of regulation ESs (e.g., pollination and flood mitigation, Wood et al., 2018). The arbitration between productivity and durability is at the very core of Sustainability science and the SDGs. It requires effort coordination and good governance. Indeed, studies show a link between political conditions (e.g., effective governance, political stability, freedom of expression, corruption control) and SDG achievement (Reverte, 2022). In sum, governance ineffectiveness challenges the possibility of implementing integrated policies and making the best use of ESs assessments and the SDGs.

4.4 | Limitations of the study

This study has several limitations. First, the participants' expertise in our interview was biased toward the natural sciences, similarly to Bull et al. (2016). Stakeholders were selected based on their knowledge of ESs, their influence on environmental management, and their availability for an interview, and they were not selected randomly. The SWOT quadrants could have differed from a representative sample (e.g., age, education level, field of work, and role). The views expressed in this paper cannot be considered representative of the case studies but as

an insight into some of the challenges and opportunities for ES-based management expressed by a limited number of participants. For this reason, conclusions could not have been drawn between types of stakeholders.

Moreover, the study provides a set of priorities based on local opportunities for ES implementation in three territories. The views expressed here are those that the interviewees gave importance to. We propose a static vision of strategies for ES-based management, reflective of the situation at a given time, which may evolve quickly. Continued monitoring is necessary to obtain up-to-date strategies.

Second, data limitations occurred for the Canary Islands case study. Only stakeholders from two of the eight islands were interviewed (Gran Canaria and Tenerife). As a result, the SWOT matrix and associated strategies may reflect the two main islands rather than the archipelago as a whole. In French Guiana, stakeholder representation is biased toward the views of public agencies. Indeed, obtaining contacts was greatly facilitated by the participants arranging direct contact with other stakeholders they believed were influential in local environmental management, such as public agencies. The high positive response rates of French Guianese stakeholders (41.9% of contacted stakeholders), displaying their interest in our study, could be explained by the higher scores on the MAES barometer. This score could indicate that higher levels of ESs implementation nurture positive perceptions of nature for its services.

Third, other factors could have been helpful in structuring the interviews, such as professional norms and codes of conduct (Saarikoski et al., 2018) or local use of ESs (Reilly et al., 2018). Indeed, pre-listing factors do not necessarily result in the identification of all the most relevant characteristics (Panagiotou & van Wijnen, 2005). However, exhaustiveness was not as essential as perceived priorities in our research. Our results could have benefited from validation and adjustment with participating stakeholders. For example, capacity building and social learning would have been enhanced with direct restitution of the results in a webinar. In these webinars, the content of the SWOT analysis could have been presented along with the strategies for implementing ESs-based strategies within the territory. The final strategies could have integrated the outcomes of these sessions for result validation.

Further research could anticipate the organization of participatory approaches to precise these strategies. For example, participants could have been asked to rank the importance of the SWOT factors (Helms & Nixon, 2010) to provide a quantitative basis for identifying priority strategies. For instance, Arsić et al. (2018) used the Analytic Network Process methodology to give a hierarchy to SWOT factors based on stakeholder ranking on a 1 to 9 scale.

In a nutshell, our results are based on the face-to-face interviewing of 38 stakeholders located in three regions, allowing for extensive qualitative data collection. We acknowledge that research design is a process that cannot allocate much time to framing the problem to solve. However, studies could benefit from problem-framing consultations with a few selected stakeholders to rapidly appraise local enablers and barriers to sustainability. This appraisal could be the first step to better connecting ES research to real-world problems while forming an audience early in the design process for disseminating results.

5 | CONCLUSIONS

The SDGs are a universal attempt to help guide a roadmap of pathways leading to sustainability for 2030. Their achievement is strongly dependent on the preservation and good management of ESs. However, evidence of the practical use of ESs assessments in support of policy and decision-making is still expected. To that end, a methodological SWOT-PESTEL framework was developed to identify strategic ES studies that fit local needs. This study tested a novel and comprehensive SWOT approach to target PESTEL determinants of sustainability and help understand how ES assessments could help address them in three representative outermost European regions. The PESTEL factors were reported in SWOT matrices to identify potential pathways to sustainability relying on ESs assessments in the Canary Islands, French Guiana, and Reunion Island. We implemented this framework by collecting qualitative data through expert interviews to pinpoint advantages and hindrances to sustainability in each case study. Applying the methodology to diverse case studies revealed different social-ecological systems and levers for sustainability, but also some similarities across case studies. Especially, our findings outline how natural resource management issues are closely intertwined with governance issues, thus confirming the need for holistic views when working toward sustainability. A lack of cooperation and trust amongst stakeholders impeded working jointly.

Hence, building on these findings, a set of recommendations is proposed to encourage ecosystem-based management as a potentially sustainable solution.

First, our study underlines the need to consider local settings to design meaningful and potentially transformative ESs assessments. Indeed, we argue that one of the reasons for the limited practical uptake of ESs approaches is the lack of inclusiveness in the problem formulation. To design high-impact ESs studies, we suggest ES practitioners consider PESE factors that enable or impede sustainability in a territory. To gain quick knowledge of the key PESE factors, we recommended meeting before the design of an ES study a few non-academic stakeholders for an interview. If ESs studies relied on actual needs and questions decision-makers have, ESs assessments could find a quicker translation into policy and decisions. The scientific community must understand decision-makers' needs and provide them with credible and relevant information, while decision-makers wish for information and effective methods to inform decisions. Thus, stakeholder engagement should occur from the beginning when framing the problem to solve and define how ESs assessments will address the issue.

Second, to manage natural resources sustainably, ecosystem-based management should be inclusive, negotiated, flexible, and adaptive to local conditions. Ultimately, decision-makers should regulate different landscape uses to support equitable and sustainable management. Indeed, unrecognized social values and ESs provided by

environments often result in inequity in development. To foster a balanced development, preserving livelihoods while achieving development needs and guaranteeing environmental conservation, land-use planners must be cautious about the interlinkages between ESs, and between SDGs. Decision-makers must recognize that ecosystems provide valuable services and that undermining one of them can lead to the loss of many more. Therefore, holistic views on challenges to sustainability, such as those proposed in this paper, can shed light on these interlinkages. Comprehensive approaches can help identify winners and losers to development as ES assessments generate co-benefits for environmental and social-related SDGs. Since SDGs are high on the political agenda, creating a clear path on the multiple contributions of ESs conservation to SDG achievement and policy outcomes could promote the use of these approaches for a more balanced view of development. Indeed, if these services are to help achieve the SDGs, decision and policy-makers must gain awareness of the drivers causing damage to ecosystem functions and their services.

Finally, our approach is consistent with the latest IPBES conceptual framework for ESs assessments adopted in December 2013, building on the Millennium Ecosystem Assessment, which is currently being tested in practice (Díaz et al., 2015). The IPBES framework includes interlinked socio-ecological components, such as institutions, governance systems, technology, and knowledge systems. It aims to support transformative change in ES application and decision-making. The potential for applying our framework is not limited to European territories. The replication of the method would allow the examination of the extent to which location-effects influence results. With the global mainstreaming of good practices for environmental management, we can assume the features identified as factors for successful ecosystem-based management could be replicated globally in different biogeographic regions (e.g., Caribbean outermost regions) or territories with different political statuses (e.g., sovereign countries, other overseas territories, or non-EU members). In sum, the methodology developed could be a valuable tool to kick-start the strategic planning process for ESs' implementation and attain more sustainable development.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The papers collected to frame this study are referenced in Supplementary Materials A (A1 and A2). The interview guidelines used for data collection are available in Supplementary Materials B. The qualitative data used for this research are unavailable due to their personal and sensitive nature. Additional data used for the analysis of this study are available in Supplementary Material C (case study code distribution, SWOT matrices, and ESs implementation strategy description).

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REFERENCES

Antonova, N., Fernández Hernández, C., González Hernández, M., Herrera Priano, F., León González, C., Mendoza Jiménez, J., Padrón Fumero, N., Rodríguez González, P., Santana Talavera, A., & Simancas Cruz, M. (2021). *Tourism observatory of the canary islands. Preliminary report* (p. 65). Cátedra de Turismo CajaCanarias-Ashotel de la Universidad de La Laguna. https://doi.org/10.25145/b.TourismCanary.2021

Arsić, S., Nikolić, D., Mihajlović, I., Fedajev, A., & Živković, Ž. (2018). A new approach within ANP-SWOT framework for prioritization of ecosystem management and case study of National Park Djerdap, Serbia. *Ecological Economics*, *146*, 85–95. https://doi.org/10.1016/j.ecolecon.2017.10.006

Atumane, A., & Cabral, P. (2021). Integration of ecosystem services into land use planning in Mozambique. *Ecosystems and People*, *17*, 165–177. https://doi.org/10.1080/26395916.2021.1903081

Balvanera, P., Brauman, K. A., Cord, A. F., Drakou, E. G., Geijzendorffer, I. R., Karp, D. S., Martín-López, B., Mwampamba, T.H., & Schröter, M. (2022). Essential ecosystem service variables for monitoring progress towards sustainability. *Current Opinion in Environmental Sustainability*, *54*, 101152. https://doi.org/10.1016/j.cosust.2022.101152

Biermann, F., Hickmann, T., Sénit, C.-A., Beisheim, M., Bernstein, S., Chasek, P., … Wicke, B. (2022). Scientific evidence on the political impact of the sustainable development goals. *Nature Sustainability*, 5, 795–800. https://doi.org/10.1038/s41893-022-00909-5

Bitoun, R. E., Trégarot, E., & Devillers, R. (2022). Bridging theory and practice in ecosystem services mapping: A systematic review. *Environment Systems and Decisions*, *42*, 103–116. https://doi.org/10.1007/s10669-021-09839-7

Bull, J., Jobstvogt, N., Böhnke-Henrichs, A., Mascarenhas, A., Sitas, N., Baulcomb, C., Lambini, C., Rawlins, M., Baral, H., Zaehringer, J., Carter-Silk, E., Balzan, M., Kenter, J., Häyhä, T., Petz, K., & Koss, R. (2016). Strengths, weaknesses, opportunities and threats: A SWOT analysis of the ecosystem services framework. *Ecosystem Services*, *17*, 99–111. https://doi.org/10.1016/j.ecoser.2015.11.012

Burkhard, B., Maes, J., Young, P., et al. (2018). Mapping and assessing ecosystem services in the EU - lessons learned from the ESMERALDA approach of integration. *One Ecosystem*, *3*, e29153. https://doi.org/10.3897/oneeco.3.e29153

Chen, C., Wang, Y., Jia, J., Mao, L., & Meurk, C. D. (2019). Ecosystem services mapping in practice: A Pasteur's quadrant perspective. *Ecosystem Services*, *40*, 101042. https://doi.org/10.1016/j.ecoser.2019.101042

Cortinovis, C., Geneletti, D., & Hedlund, K. (2021). Synthesizing multiple ecosystem service assessments for urban planning: A review of approaches, and recommendations. *Landscape and Urban Planning*, *213*, 104129. https://doi.org/10.1016/j.landurbplan.2021.104129

Cowling, R. M., Egoh, B., Knight, A. T., O'Farrell, P. J., Reyers, B., Rouget, M., Roux, D.J., Welz, A., & Wilhelm-Rechman, A. (2008). An operational model for mainstreaming ecosystem services for implementation. *Proceedings of the National Academy of Sciences*, *105*, 9483–9488. https://doi.org/10.1073/pnas.0706559105

Daily, G. C., & Matson, P. A. (2008). Ecosystem services: From theory to implementation. *Proceedings of the National Academy of Sciences*, *105*, 9455–9456. https://doi.org/10.1073/pnas.0804960105

De Geyer, J.-F., Launay, J., Heuertz, M., Tysklind, N., Scotti, I., Molino, J.-F., Delprete, P., Engel, J., Frame, D., Lucas, E., Martin, C., & Sabatier, D. (2020). *Deuxième rapport sur l'état des ressources génétiques forestières mondiales. Rapport national de la France* (Vol. 3, p. 123). INRAE.

de Vries, B. J. M. (2019). Engaging with the sustainable development goals by going beyond modernity: An ethical evaluation within a worldview framework. *Global Sustainability*, *2*. https://doi.org/10.1017/sus.2019.15

Demougeot, L., & Baert, X. (2019). La population guyanaise à l'horizon 2050: Vers un doublement de la population? (Insee Analyses Guyane No. 36). INSEE.

Díaz, S., Demissew, S., Carabias, J., Joly, C., Lonsdale, M., Ash, N., Larigauderie, A., Adhikari, J.R., Arico, S., Báldi, A., Bartuska, A., Baste, I.A., Bilgin, A., Brondizio, E., Chan, K.M., Figueroa, V.E., Duraiappah, A., Fischer, M., Hill, R., … Zlatanova, D. (2015). The IPBES conceptual framework — Connecting nature and people. *Current Opinion in Environmental Sustainability*, *14*, 1–16. https://doi.org/10.1016/j.cosust.2014.11.002

Douglas, C. H. (2006). Small Island states and territories: Sustainable development issues and strategies – Challenges for changing islands in a changing world. *Sustainable Development*, *14*, 75–80. https://doi.org/10.1002/sd.297

EC. (2019). *The European Green Deal (Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions No. COM/2019/640)*. European Commission.

Erdogan, H. E., Havlicek, E., Dazzi, C., Montanarella, L., Van Liedekerke, M., Vrščaj, B., Krasilnikov, P., Khasankhanova, G., & Vargas, R. (2021). Soil conservation and sustainable development goals (SDGs) achievement in Europe and central Asia: Which role for the European soil partnership? *International Soil and Water Conservation Research*, *9*, 360–369. https://doi.org/10.1016/j.iswcr.2021.02.003

Geijzendorffer, I. R., Cohen-Shacham, E., Cord, A. F., Cramer, W., Guerra, C., & Martín-López, B. (2017). Ecosystem services in global sustainability policies. *Environmental Science and Policy*, *74*, 40–48. https://doi.org/10.1016/j.envsci.2017.04.017

Gkoltsiou, A., & Mougiakou, E. (2021). The use of Islandscape character assessment and participatory spatial SWOT analysis to the strategic planning and sustainable development of small islands. The case of Gavdos. *Land Use Policy*, *103*, 105277. https://doi.org/10.1016/j.landusepol.2021.105277

Goodman, L. A. (1961). Snowball sampling. *The Annals of Mathematical Statistics*, *32*, 148–170. https://doi.org/10.1214/aoms/1177705148

Grunewald, K., Bastian, O., Louda, J., Arcidiacono, A., Brzoska, P., Bue, M., Cetin, N.I., Dworczyk, C., Dubova, L., Fitch, A., Jones, L., Rosa, D.L., Mascarenhas, A., Ronchi, S., Schlaepfer, M.A., Sikorska, D., & Tezer, A. (2021). Lessons learned from implementing the ecosystem services concept in urban planning. *Ecosystem Services*, *49*, 101273. https://doi.org/10.1016/j.ecoser.2021.101273

Haines-Young, R., & Potschin, M. (2010). The links between biodiversity, ecosystem services and human well-being. In C. L. J. Frid & D. G. Raffaelli (Eds.), *Ecosystem ecology: A new synthesis*, *ecological reviews* (pp. 110–139). Cambridge University Press. https://doi.org/10.1017/CBO9780511750458.007

Haines-Young, R., & Potschin-Young, M. B. (2018). Revision of the common international classification for ecosystem services (CICES V5.1): A policy brief. *One Ecosystem*, *3*, e27108. https://doi.org/10.3897/oneeco.3.e27108

Hammond, D. S., Gond, V., Thoisy, B. de, Forget, P.-M., & DeDijn, B. P. E. (2007). Causes and Consequences of a Tropical Forest Gold Rush in the Guiana Shield, South America. *AMBIO: A Journal of the Human Environment*, *36*(8), 661–670. https://doi.org/10.1579/0044-7447(2007)36[661:cacoat]2.0.co;2

Helms, M. M., & Nixon, J. (2010). Exploring SWOT analysis – Where are we now? *Journal of Strategy and Management*, *3*, 215–251. https://doi.org/10.1108/17554251011064837

Henfrey, T., Feola, G., Penha-Lopes, G., Sekulova, F., & Esteves, A. M. (2022). Rethinking the sustainable development goals: Learning with and from community-led initiatives. *Sustainable Development*, *1*, 1– 12. https://doi.org/10.1002/sd.2384

Inc., P. T. (2015). *Collaborative data science*. Plotly Technologies Inc https://plot.ly

Inkoom, J. N., Frank, S., & Fürst, C. (2017). Challenges and opportunities of ecosystem service integration into land use planning in West Africa – An implementation framework. *International Journal of Biodiversity Science, Ecosystem Services and Management*, *13*, 67–81. https://doi.org/10.1080/21513732.2017.1296494

IPBES. (2019). Summary for policymakers of the global assessment report on biodiversity and ecosystem services. *Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. Bonn, Germany: IPBES secretariat; 56. https://doi.org/10.5281/zenodo.3553579

Jax, K., Furman, E., Saarikoski, H., Barton, D. N., Delbaere, B., Dick, J., Duke, G., Görg, C., Gómez-Baggethun, E., Harrison, P.A., Maes, J., Pérez-Soba, M., Saarela, S.-R., Turkelboom, F., van Dijk, J., & Watt, A. D. (2018). Handling a messy world: Lessons learned when trying to make the ecosystem services concept operational. *Ecosystem Services*, *29*, 415–427. https://doi.org/10.1016/j.ecoser.2017.08.001

Jetoo, S., & Lahtinen, V. (2021). The good, the bad and the future: A SWOT analysis of the ecosystem approach to governance in the Baltic Sea region. *Sustainability*, *13*, 10539. https://doi.org/10.3390/su131910539

Johnson, J. A., Jones, S. K., Wood, S. L. R., Chaplin-Kramer, R., Hawthorne, P. L., Mulligan, M., Pennington, D., & De Clerck, F. A. (2019). Mapping ecosystem services to human well-being: A toolkit to support integrated landscape management for the SDGs. *Ecological Applications*, *29*, e01985. https://doi.org/10.1002/eap.1985

Kates, R. W. (2016). Sustainability science. In *International encyclopedia of geography* (pp. 1–4). John Wiley & Sons, Ltd. https://doi.org/10.1002/9781118786352.wbieg0279

Kluza, K., Zioło, M., Bąk, I., & Spoz, A. (2021). Achieving Environmental Policy Objectives through the Implementation of Sustainable Development Goals. The Case for European Union Countries. *Energies*, 14(8), 1–22. https://doi.org/10.3390/en14082129

Lautenbach, S., Mupepele, A.-C., Dormann, C. F., Lee, H., Schmidt, S., Scholte, S. S. K., Seppelt, R., van Teeffelen, A.J.A., Verhagen, W., & Volk, M. (2019). Blind spots in ecosystem services research and implementation. *Regional Environmental Change.*, *19*, 2151–2172. https://doi.org/10.1007/s10113-018-1457-9

Longato, D., Cortinovis, C., Albert, C., & Geneletti, D. (2021). Practical applications of ecosystem services in spatial planning: Lessons learned from a systematic literature review. *Environmental Science and Policy*, *119*, 72–84. https://doi.org/10.1016/j.envsci.2021.02.001

Martinez-Harms, M. J., Bryan, B. A., Balvanera, P., Law, E. A., Rhodes, J. R., Possingham, H. P., & Wilson, K. A. (2015). Making decisions for managing ecosystem services. *Biological Conservation*, *184*, 229–238. https://doi.org/10.1016/j.biocon.2015.01.024

Martinez-Harms, M. J., Gelcich, S., Krug, R. M., Maseyk, F. J. F., Moersberger, H., Rastogi, A., Wambugu, G., Krug, C.B., Spehn, E.M., & Pascual, U. (2018). Framing natural assets for advancing sustainability research: Translating different perspectives into actions. *Sustainability*

Science, *13*, 1519–1531. https://doi.org/10.1007/s11625-018-0599-5

Miles, M. B., Huberman, M. A., & Saldaña, J. (2019). *Qualitative data analysis: A methods sourcebook* (4th ed.). Sage Publications, Inc.

Millennium Ecosystem Assessment. (2005). *Ecosystems and human well-being: Synthesis*. Island Press.

MOVE-ON Project. (2021). European Commission Directorate General Environment Grant Agreement no. 07.02.7735/2019/808239/SUB/ENV.D2. Deliverable D4.1 Database of MAES projects and experts; p. 37.

Nahuelhual, L., Vergara, X., Bozzeda, F., Campos, G., Subida, M. D., Outeiro, L., Villasante, S., & Fernandez, M. (2020). Exploring gaps in mapping marine ecosystem services: A benchmark analysis. *Ocean and Coastal Management*, *192*, 105193. https://doi.org/10.1016/j.ocecoaman.2020.105193

Nilsson, M., Griggs, D., & Visbeck, M. (2016). Policy: Map the interactions between sustainable development goals. *Nature*, *534*, 320–322. https://doi.org/10.1038/534320a

Øivind Madesn, D., & Ove Grønseth, B. (2022). PEST analysis. Encyclopedia of Tourism Management and Marketing.

Panagiotou, G., & van Wijnen, R. (2005). The "telescopic observations" framework: An attainable strategic tool. *Marketing Intelligence and Planning*, *23*, 155–171. https://doi.org/10.1108/02634500510589912

Patton, M. Q. (1999). Enhancing the quality and credibility of qualitative analysis. *Health Services Research*, *34*(5), 1189–1208.

Pejchar, L., & Mooney, H. (2009). Invasive species, ecosystem services and human well-being. *Trends in Ecology & Evolution*, *9*, 497–504. https://doi.org/10.1016/j.tree.2009.03.016

Reid, W. V., Mooney, H. A., Capistrano, D., Carpenter, S. R., Chopra, K., Cropper, A., Dasgupta, P., Hassan, R., Leemans, R., May, R.M., Pingali, P., Samper, C., Scholes, R., Watson, R.T., Zakri, A.H., & Shidong, Z. (2006). Nature: The many benefits of ecosystem services. *Nature*, *443*, 749. https://doi.org/10.1038/443749a

Reilly, K., Adamowski, J., & John, K. (2018). Participatory mapping of ecosystem services to understand stakeholders' perceptions of the future of the Mactaquac dam, Canada. *Ecosystem Services*, *30*, 107–123. https://doi.org/10.1016/j.ecoser.2018.01.002

Reverte, C. (2022). The importance of institutional differences among countries in SDGs achievement: A cross-country empirical study. *Sustainable Development*, *1*, 1-18. https://doi.org/10.1002/sd.2354

Saarikoski, H., Primmer, E., Saarela, S.-R., Antunes, P., Aszalós, R., Baró, F., Berry, P., Blanko, G.G., Goméz-Baggethun, E., Carvalho, L., Dick, J., Dunford, R., Hanzu, M., Harrison, P.A., Izakovicova, Z., Kertész, M., Kopperoinen, L., Köhler, B., Langemeyer, J., … Young, J. (2018). Institutional challenges in putting ecosystem service knowledge in practice. *Ecosystem Services*, *29*, 579–598. https://doi.org/10.1016/j.ecoser.2017.07.019

Sachs, J., Lafortune, G., Kroll, C., Fuller, G., & Woelm, F. (2022). From crisis to sustainable development: The SDGs as roadmap to 2030 and beyond. In *Sustainable development report 2022*. Cambridge University Press.

Saldaña, J. (2015). *The coding manual for qualitative researchers* (3rd ed.). Sage Publications, Inc.

Saliman, M., Benon, P., Gosset, M., Mariotti, S., Bracco, I., Julliot, C., Le Tellier, V., Staal, S., Besnard, A., Malfait, G., & Reilhes, C. (2017). *La biodiversité à La Réunion à travers 20 indicateurs* (p. 44). DEAL Réunion.

Sammut-Bonnici, T., & Galea, D. (2015). PEST analysis. In *Wiley encyclopedia of management, strategic management* (pp. 1). John Wiley and Sons, Ltd. https://doi.org/10.1002/9781118785317.weom120113

Sharpe, B., Hodgson, A., Leicester, G., Lyon, A., & Fazey, I. (2016). Three horizons: A pathways practice for transformation. *Ecology and Society*, *21*, 47. https://doi.org/10.5751/ES-08388-210247

Steurer, R. (2021). Is the EU still committed to developing more sustainably? In *Environmental policy in the EU* (p. 20). Routledge.

Strasberg, D., Rouget, M., Richardson, D. M., Baret, S., Dupont, J., & Cowling, R. M. (2005). An assessment of habitat diversity and transformation on La Réunion Island (Mascarene Islands, Indian Ocean) as a basis for identifying broad-scale conservation priorities. *Biodiversity and Conservation*, *14*, 3015–3032. https://doi.org/10.1007/s10531-004-0258-2

UN. (2015). Transforming our world: The 2030 agenda for sustainable development General Assembly 70th session No. A/RES/70/1. United Nations.

UN. (2019). The future is now. Science for achieving sustainable development (No. Global Sustainable Development Report). United Nations, New York.

Weitzman, J. (2019). Applying the ecosystem services concept to aquaculture: A review of approaches, definitions, and uses. *Ecosystem Services*, *35*, 194–206. https://doi.org/10.1016/j.ecoser.2018.12.009

Wood, S. L. R., Jones, S. K., Johnson, J. A., Brauman, K. A., Chaplin-Kramer, R., Fremier, A., Girvetz, E., Gordon, L.J., Kappel, C.V., Mandle, L., Mulligan, M., O'Farrell, P., Smith, W.K., Willemen, L., Zhang, W., & DeClerck, F. A. (2018). Distilling the role of ecosystem services in the sustainable development goals. *Ecosystem Services*, *29*, 70–82. https://doi.org/10.1016/j.ecoser.2017.10.010

Yang, S., Zhao, W., Liu, Y., Cherubini, F., Fu, B., & Pereira, P. (2020). Prioritizing sustainable development goals and linking them to ecosystem services: A global expert's knowledge evaluation. *Geography and Sustainability*, *1*, 321–330. https://doi.org/10.1016/j.geosus.2020.09.004

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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