Pursuing Legitimate and Effective Protected Area Management:

An Assessment of Governance, Economic Impacts and Sustainability in Iceland

Jukka Kalervo Siltanen

Thesis for the degree of PhD
in Environment and Natural Resources

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FACULTY OF ECONOMICS

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Leit að réttmætri og skilvirkri stjórnun friðlýstra svæða:

Mat á stjórnarháttum, efnahagslegum áhrifum og sjálfbærni á Íslandi

Jukka Kalervo Siltanen

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Ágrip

Nýlegt samkomulag samnings Sameinuðu þjóðanna um líffræðilega fjölbreytni (CBD), svokallað Kunming-Montreal rammasamkomulag um líffræðilega fjölbreytni (e. Global Biodiversity Framework, KM-GBF) setur metnaðarfullt markmið um að vernda 30% alls lands og hafs og einnig að tryggja að öllu vernduð svæði séu með skilvirkri stjórnun og stjórnkerfi þeirra séu réttlát. Ísland hefur byggt upp umfangsmikið kerfi friðlýstra svæða þar sem fjölbreyttum stjórnkerfum er beitt til að mæta ólíkum þörfum hagsmunaaðila í heimabyggð og áskorunum tengdum örum vexti náttúrutengdrar ferðaþjónustu. Meginmarkmið þessarar ritgerðar er að efla skilning á stjórnun friðlýstra svæða með því að gera víðtækt mat á stjórnkerfum, efnahagslegum áhrifum og sjálfbærni, þar sem íslensk friðlýst svæði eru notuð sem rannsóknavettvangur. Þetta er gert með fjórum tengdum tímaritsgreinum sem hafa eftirfarandi markmið: að skilja áhrif mismunandi stjórnkerfa friðlýstra svæða á hæfni þeirra til stjórnunar, að meta efnahagsleg áhrif friðlýstra svæða í samhengi við takmarkaðar hagrænar upplýsingar, að rannsaka áskoranir, tækifæri og takmarkanir við notkun sérleyfissamninga til að stýra ferðaþjónustu í atvinnuskyni á friðlýstum svæðum, og að kanna hvernig hægt er að leggja mat á sjálfbærni og skilvirkni stjórnunar friðlýstra svæða með samþættum greiningarramma. Í ritgerðinni er beitt fjölbreyttum rannsóknaaðferðum, eða greiningu á stjórnkerfum, efnahagslegum áhrifagreiningum byggðum á MGM2-aðferðafræði, hálfstöðluðum og kóðuðum viðtölum, skipulagðri heimildaleit með það að leiðarljósi að meta skilvirkni og sjálfbærni stjórnunar friðlýstra svæða

Doktorsritgerðin skiptist í fjórar samþættar rannsóknir. Þróaður var greiningarrammi fyrir stjórnkerfi friðlýstra svæða, þar með talinn skilning á þeim þáttum sem leiddu til stofnunar þeirra og gerð stofnanagreining á völdum íslenskum friðlýstum svæðum. Niðurstöður rannsóknarinnar sýna að fjölbreytt stjórnkerfi eru styrkleiki sem eykur réttmæti og aðlögunarhæfni friðlýstra svæða, en ólík stjórnkerfi skapa jafnframt samhæfingaráskoranir. Til að rannsaka efnahagsleg áhrif friðlýstra svæða var þróuð staðbundin aðferðafræði, sem sýndi að þau áhrif voru veruleg og er það nýnæmi að geta gert slíkar rannsóknir í samfélögum þar sem hagræn gögn eru takmörkuð líkt og á Íslandi. Unnið var jafnframt með áskoranir, takmarkanir og tækifæri við beitingu sérleyfissamninga sem efnahagslegra stjórntækja á friðlýstum svæðum sérstaklega varðandi ferðaþjónustu. Stjórnendur friðlýstra svæða og ferðaþjónustufyrirtæki líta að mestu leyti jákvæðum augum á sérleyfissamninga; hins vegar eru áskoranir enn til staðar vegna skorts á faglegri getu, lagalegri óvissu og jafnræðis aðila. Samþætt greining á skilvirkni stjórnunar og sjálfbærni var jafnframt gerð í íslenskum þjóðgörðum, sem byggði á sjálfsmatstæki Alþjóðlegu náttúruverndarsamtakanna (IUCN) sem kallast Græni listinn (Green List). Græni listinn reyndist sérstaklega

gagnlegt tæki, samræmdist vel stoðum sjálfbærni og sjálfbærnimarkmiðum Sameinuðu þjóðanna og styður þannig við sjálfbærni á friðlýstum svæðum.

Þessar rannsóknir á stjórn friðlýstra svæða draga fram að félagslegt og efnahagslegt jafnræði ásamt þátttöku haghafa, séu nauðsynleg atriði til að stuðla að réttmætri og skilvirkri stjórnun slíkra svæða. Það endurspeglar alþjóðlegar niðurstöður um að samstjórn og staðbundnar áherslur séu árangursríkar leiðir til ná jákvæðum félagslegum niðurstöðum og efla náttúruvernd. Til framtíðar kallar þetta á stjórnkerfi sem geti stuðlað að aukinni þátttöku haghafa og geti samþætt ólíkar stefnur og sjónarmið og dregið úr árekstrum. Mikilvægt er að byggja ákvarðanir á gögnum sem ásamt árangursmiðuðum matstækjum munu fela í sér nýjar tegundir af samstarfi milli staðbundinna hagsmunaaðila, vísindamanna og stjórnvalda friðlýstra svæða. Frekari rannsókna er þörf á hvernig megi skilja megi betur og hagnýta þekkingu á stjórnkerfum, félags-hagrænum áhrifum og árangri náttúruverndar á friðlýstum svæðum með margþættri landnotkun.

Lykilorð:

Stjórnun friðlýstra svæða, stjórnkerfi, efnahagsleg áhrif, sérleyfissamningar, sjálfbærni

Abstract

Under the United Nations Convention for Biodiversity (CBD), countries have recently agreed on the Kunming-Montreal Global Biodiversity Framework (KM-GBF) and set an ambitious target of not only protecting 30% of all lands and seas—but also ensuring that all protected areas (PA) are effectively and equitably managed, sustainable, and deliver fair benefits to people. Iceland has a significant PA estate, applying diverse governance models in response to various needs from local stakeholders and to the challenges related to rapid growth of nature-based tourism. The main objective of this dissertation is to advance the understanding of PA management by providing a broad assessment of PA governance, economic impacts, sustainability and their management implications employing Icelandic PAs as case studies. This is accomplished through four interrelated papers with the following overall objectives: understanding the impact of governance arrangements on adaptive PA management capacity, assessing the economic impacts of PAs in the context of limited economic data, examining the challenges, opportunities and constraints in using concessions to regulate commercial PA tourism, and exploring how PA sustainability and management effectiveness can be evaluated in a single integrated framework. The dissertation employs a combination of governance analysis, economic impact analysis based on MGM2 methodology, semi-structured and coded interviews, narrative literature reviews and practical experiments with management effectiveness tools and sustainability frameworks.

An analytical framework for PA governance analysis including historical trajectories is developed and tested with a comparative institutional analysis of selected Icelandic PAs. The results from the study show that governance diversity can be seen as a strength, increasing PA legitimacy and adaptive capacity, but it has also created coordination challenges. A localised methodology for calculating economic impacts is established, showing how the socio-economic impacts from PA tourism have been significant and providing a technique for contexts with limited economic data. The challenges, constraints and opportunities of concessions as economic instruments are further analysed. PA managers and businesses see concessions largely as positive instruments; however, challenges remain due to lack of capacity, legal ambiguities and in particular social equity concerns. A synthesising analysis on management effectiveness and sustainability is provided by piloting the IUCN Green List self-assessment tool in Icelandic NPs. The Green List was found to be a particularly useful tool in identifying gaps in data and existing assessments. It was also found to align well with the sustainability pillars and the United Nations Sustainable Development Goals, supporting PA sustainability efforts.

Socio-economic equity and meaningful stakeholder inclusion emerge as essential components of legitimate and effective PA management, echoing international findings that shared or local governance arrangements typically produce better social and conservation outcomes. In the future, this calls for more inclusive, participatory governance models and a greater integration of potentially seemingly competing policy objectives. Data-driven and outcome-oriented assessments will likely involve new kinds of partnerships between the local stakeholders, researchers and PA authorities. Further research is needed on operationalising governance, socio-economic impacts and conservation outcomes in multi-use landscapes, particularly in locally-managed PAs.

Keywords:
Protected area management, governance, economic impacts, concessions, sustainability

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As the work on my dissertation nears its end, I would first like to offer my deepest and most sincere thank you to my doctoral committee for their immeasurable support in guiding me through the papers and the writing process. My immediate supervisor Jon Geir Petursson has been a brilliant mentor through this journey. We have discussed issues related to the thesis and other protected area developments almost on a daily to weekly basis, and I have learned much from the courses that we have taught together. Brynhildur Davidsdottir has offered invaluable expertise in design and analysis of the individual papers as well as the dissertation manuscript and has always asked the most difficult questions. David Cook has always been there for support and discussions and is the most efficient reviewer and commenter in the world. Thank you all.

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Through this dissertation, I have worked in close cooperation with the Icelandic national parks and protected areas. I would like to thank all my friends and contacts in the respective park authorities for your time and support in participating in the studies and helping me to collect data. Without you this work would not have been possible. Additionally, I would like to extend a special thanks to Þingvellir National Park, where I have been working as a ranger for part of this PhD process and learning about nature conservation in the field – your flexibility has allowed me to teach on courses related to the topics I write about in this dissertation, as well as allowing me to take study leave to finish the writing of this manuscript. Thank you.

I would also like to thank the IUCN team for the collaboration, support and training provided for the Green List self-assessment tool pilot study.

Finally, I would like to thank my family members for their support in this long process. You have always been there for support and encouragement, taking responsibility at home when I have been working. For all that, I am eternally grateful.

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List of Abbreviations

CA	Conservation Area
CBD	Convention on Biological Diversity
CUA	Commercial Use Act
EGS	Environmental Governance System
ES	Ecosystem Services
ESG	Environmental, Social, Governance
FLQ	Flegg Location Quotient
GD-PAME	Global Database on Protected Area Management Effectiveness
GLS	Green List Standard
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IUCN	International Union for Conservation of Nature
IUCN-WCPA	IUCN World Commission on Protected Areas
KM-GBF	Kunming-Montreal Global Biodiversity Framework
LQ	Location Quotient
MEPCA	Management Effectiveness Process for Conservation Areas
METT	Management Effectiveness Tracking Tool
NCA	Nature Conservation Act
NP	National Park
NR	Nature Reserve
OECD	The Organisation for Economic Co-operation and Development
OECM	Other Effective Area-Based Conservation Measure
PA	Protected Area
PAME	Protected Area Management Effectiveness

PPA	Privately Protected Area
SAF	Samtök ferðaþjónustunnar (Icelandic Travel Industry Association)
SDG	Sustainable Development Goals
SES	Social-Ecological System
TCM	Travel Cost Method
UN	United Nations
UN-CBD	United Nations Convention on Biological Diversity
UNCED	UN Conference on Environment and Development
UNEP-WCMC	UN Environment Programme World Conservation Monitoring Centre
UNESCO	The United Nations Educational, Scientific and Cultural Organization
VAT	Value Added Tax
WHS	World Heritage Site

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List of Original Papers

This thesis is based on the following original publications, which are referred to in the text by their Roman numerals:

I. Siltanen, J., Petursson, J. G., Cook, D., & Davidsdottir, B. (2022). Diversity in Protected Area Governance and Its Implications for Management: An Institutional Analysis of Selected Parks in Iceland. Land, 11(2), 315. doi:10.3390/land11020315.

II. Siltanen, J., Petursson, J. G., Cook, D., & Davidsdottir, B. (2023). Evaluating economic impacts of protected areas in contexts with limited data; the case of three national parks in Iceland. Journal of Environmental Management, 342, 118085. doi:10.1016/j.jenvman.2023.118085.

III. Siltanen, J., Petursson, J. G., Cook, D., & Davidsdottir, B. (2026). Developing Economic Policy Instruments for Tourism Management in Protected Areas. Environmental management, 76(22). doi:10.1007/s00267-025-02324-w. Reproduced with permission from Springer Nature.

IV. Siltanen, J., Petursson, J. G., Cook, D., & Davidsdottir, B. (2026). Challenges in achieving a global standard for protected area management effectiveness in the context of sustainability: analysis of the IUCN Green List. Submitted for publication, available as pre-print: doi:10.2139/ssrn.6021713.

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Declaration of Contribution

I have contributed to the project planning, research formulation, data collection, analysis, conclusions and synthesis in the following ways:

1. Planning and formulation
    a. Wrote the draft of the research project proposal and integrated feedback from my main supervisor.
    b. Formulated the research questions for the individual papers and integrated feedback from my supervisor and supervisory committee.
    c. Developed the research design and methodological frameworks for each individual paper with feedback from my supervisory committee.
2. Data collection
    a. Completed a literature review for each article.
    b. Collected and transcribed semi-structured interview data for Papers I, III and IV.
    c. Completed top-down elaborative coding for interview data for Papers III and IV.
    d. Collected additional visitor spending data (N=986) for Paper II to supplement datasets from earlier research projects.
    e. Collected various economic data for Paper II from Icelandic and international economic databases.
    f. Completed a review of the Icelandic concession system for Paper III.
    g. Organised a practical experiment of the IUCN Green List self-assessment tool prototype with the Icelandic national parks in cooperation with IUCN development and training team.
3. Data analysis and writing
    a. Analysed qualitative interview data for Papers I, III and IV.
    b. Analysed the legal and regulatory framework for Papers I and III.
    c. Developed a localised economic impact model in Paper II that combines the MGM2 methodology approach with Location Quotient (LQ) -regionalised input-output tables.
    d. Set the results from the analyses in a wider protected area context and integrated feedback from my supervisory committee.

e. Wrote the initial draft of all individual papers and integrated feedback from the supervisory committee and reviewers.

f. Wrote the dissertation manuscript, providing a wider theoretical and practical context for the individual papers, short summaries of each paper, and overarching discussion regarding the individual papers, contributions, limitations and future research prospects, integrating feedback from the supervisory committee.

4. Conclusions and synthesis

g. Generated policy recommendations from the results of each individual paper and synthesised overarching findings in this manuscript.

h. Identified limitations in the research and provided suggestions for future research questions.

These contributions demonstrate how this research project provides insights to current issues and research needs in Iceland and is applicable in the wider international context. The discussions and feedback from my supervisors have been pivotal in refining the project and independent research papers.

1 Introduction

Protected areas (PA) are the primary global tool to conserve biodiversity and essential ecosystem services (ES) while aiming to ensure equitable governance, sustainable use of resources and rights of the local stakeholders and Indigenous peoples (UNEP-WCMC and IUCN, 2024). PAs are a major land-use category globally, accounting for 17.6% of terrestrial lands and 8.4% of the seas in over 300,000 designations and set to expand to 30% for both land and seas by 2030 according to the Kunming-Montreal Global Biodiversity Framework (KM-GBF) Target 3 (CBD, 2022; UNEP-WCMC and IUCN, 2026). While the '30 by 30' designation goal is the most quoted part of the Target 3, improving management effectiveness and equitability of the PAs are equally at the core of the target (ibid). The KM-GBF also counts areas outside of PAs that deliver long-term biodiversity conservation, Other Effective Area-based Conservation Measures (OECM), towards the target (Jonas et al., 2024).

Despite a significant expansion of the PA estate in the last decades, conservation efforts fell short of the United Nations Convention on Biological Diversity (UN-CBD) Aichi Biodiversity Target 11 of global 17/10% land/sea coverage by 2020 (CBD, 2010; Hilty et al., 2020). Additionally, studies have shown that biodiversity and ESs are still deteriorating despite the rapid increase in PAs, suggesting PAs do not cover critical biodiversity areas and/or are not effectively managed (IPBES, 2019). These findings call for urgent improvements in management effectiveness and equitable governance, as well as setting more focus on rigorous assessment of biodiversity values and PA connectivity in connection with PA estate expansion (Maxwell et al., 2020; Pedersen et al., 2026; UNEP-WCMC and IUCN, 2024).

Recent conventions have placed equitable governance as a binding global policy focus and highlighted the importance of ensuring sustainable use of natural resources and economic benefits for the rightsholders in and around PAs (CBD, 2010, 2022). However, global conservation practices were initially slow to acknowledge the rights of local and Indigenous peoples and a source of many conflicts (Adams & Hutton, 2007; Brockington et al., 2008; West et al., 2006). Social and economic values related to conservation were recognised in the World Conservation Strategy in 1980, which called for aligning global conservation and sustainable development strategies (IUCN et al., 1980), followed by the IUCN providing the first set of guidelines on how to develop and assess economic impacts from PAs in 1990s (IUCN, 1998). Growing understanding of ES, now well-established in the literature, has also tied PAs to our efforts to secure continued functioning of Earth's life-support system and benefits to human welfare since the first assessment on the aggregate economic value of the world's ES and natural capital (Costanza et al., 1997).

1.1 PAs as governance systems

Most natural resources are embedded in complex social-ecological systems, where a governance system regulates their use (Ostrom, 2009). Governance can be defined as exercising political, economic and administrative authority in the management of a particular issue, comprising of mechanisms, processes and institutions through which actors articulate their interests, mediate differences and exercise their legal rights and obligations (Graham et al., 2003; UNDP, 1997). Environmental governance systems are formed by the institutions, actors and natural resources, and their interactions (Vatn, 2015). Institutions are defined as "sets of rules, decision-making procedures and programs that define social practices, assign roles to the participants in these practices and guide interactions among the occupants of individual roles," (Young, 2002, p. 5). Institutions can be constitutional or policy-related such as laws or regulations, or management-related as rules, norms or social conventions (Vatn, 2015). PAs are defined as "clearly defined geographical spaces, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (Dudley, 2008, p. 2). National governments generally designate PAs by legal means, placing the PA within the national legal and policy framework. This is then followed by the defining of a governance system for the PA with a set actors, roles and mandates as the institutional structures to ensure conservation with rules and access and use. This study understands governance as "the interactions among structures, processes, and traditions that determine how power and responsibilities are exercised, how decisions are taken, and how citizens or other stakeholders have their say" (Graham et al., 2003, p. ii). Innovations and improvements in governance have the greatest potential to enable PA estate expansion and are also important factors for effectiveness; thus, a critical aspect of PA design (Borrini-Feyerabend et al., 2013).

IUCN categorises PA governance in four main types based their lead actor: 1) by government, 2) by shared arrangements between rights- and stakeholders, 3) by private actors and 4) by Indigenous peoples and/or local communities (Borrini-Feyerabend et al., 2013). This broad typology contains multiple variations and there can even be nested governance arrangements (Borrini-Feyerabend & Hill, 2015). The origins of many PAs initially stem from sacred sites, community-based initiatives to conserve resources or lands set aside for hunting and wildlife by wealthy individuals; however, governments largely took over PA formation in 19th and 20th centuries (Borrini-Feyerabend et al., 2013). Many early government efforts—later dubbed the 'fortress approach'—were characterised by displacement of local people combined with harsh top-down control and enforcement, leading to conflicts and multiple failures in their conservation delivery (Adams et al., 2004; Adams & Infield, 2003; Dahlberg et al., 2010; Naughton-Treves et al., 2005). In response to the challenges of top-down methods, community-based conservation initiatives started to emerge in the 1980s and 90s (Brockington, 2002; Hutton et al., 2005). After a brief 'back to the barriers'

period, where some failed community conservation initiatives led to resurging calls for stricter government approaches, PAs have gradually moved towards a variety of more inclusive, shared governance models to recognise and respect the rights of the rightsholders and views of all stakeholders (Dawson et al., 2021; Fidler et al., 2022; Hutton et al., 2005). As a result, the complexity of the governance arrangements has increased, followed by a need for new analytical tools to improve governance (Lockwood, 2010).

PA governance systems are inseparably tied to the surrounding historical, socio-cultural and institutional contexts, and thus these aspects need to be included in governance analysis and development (Borrini-Feyerabend et al., 2013; Borrini-Feyerabend & Hill, 2015; Petursson & Vedeld, 2015; Soliku & Schraml, 2018). Ostrom and Cox (2010) call for analysing social-ecological systems (SES) to accommodate the diversity of governance approaches and actors. Vatn's environmental governance system (EGS) framework focuses on the institutions and their interactions with actors and resources towards more sustainable outcomes (Vatn, 2015, 2020). A variety of institutional analyses show conservation outcomes vary, primarily due to governance approaches and local contexts; and the more inclusive and participatory governance approaches are, the better are the conservation outcomes (Badola et al., 2018; Dawson et al., 2024; De Pourcq et al., 2016; Järv et al., 2021; Nyaupane et al., 2022; Oldekop et al., 2016).

1.2 Policy instruments in a PA context

Policy instruments are a set of tools, techniques or 'governing instruments' used by governments to implement public policy goals and address problems (Fischer et al., 2023). They are broadly classified as regulatory (or administrative), economic and informational (Palm & Larsson, 2007). Regulatory instruments are direct government interventions that control potentially harmful activities through legal means and rely on public authorities for enforcement (Fischer et al., 2023; Lambin et al., 2014). Examples of regulatory instruments in a PA context involve different legal PA designations, zoning plans and restrictions on harvesting resources (Ackerschott et al., 2023). Economic instruments work by setting a monetary value on natural resources to influence decision-making and provide financial incentives rather than prohibitions, e.g. taxes, charges and subsidies (ibid). PAs use a variety of economic instruments to regulate visitation and generate revenue by collecting entrance and user fees, issuing concessions and service contracts (Font et al., 2004). These are often essential for the financial sustainability of the PA, and it is important for policy instrument design to understand how they are collected and allocated (ibid). Finally, informational (or motivational) instruments build on increased knowledge and awareness, educational materials and labelling to influence decision-making towards conservation (Fischer et al., 2023). Figure 1 provides examples of these instruments.

Policy instruments are commonly employed in mixes and hybrid-approaches to address complex environmental and socio-economic issues and multiple policy goals (Ackerschott et al., 2023; Blackstock et al., 2021; Fischer et al., 2023; Lambin et al., 2014; Ring & Barton, 2015). Recent national and international policies have advocated the use of economic instruments and incentives as a preferred 'carrot' approach, though often supported by regulatory 'stick' policies (Fischer et al., 2023).

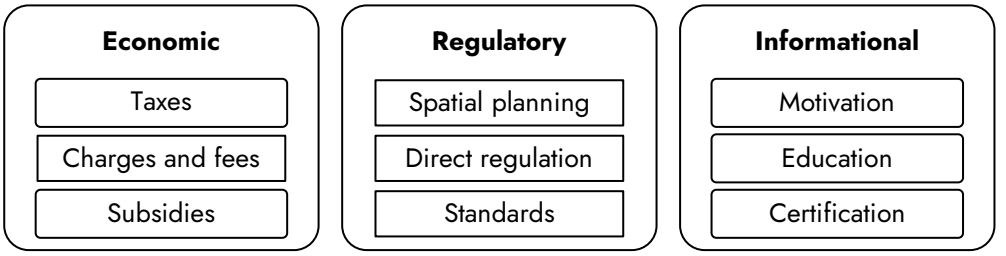


Figure 1. Examples of policy instruments by category; adapted from (Ackerschott et al., 2023; Fischer et al., 2023; Ring & Barton, 2015; Spenceley et al., 2021)

1.3 PA management approaches, challenges and effectiveness

Management is a narrower concept than governance and in a PA context generally concerns the resources, plans and actions to achieve objectives, while governance defines who holds power, responsibility and accountability (Borrini-Feyerabend et al., 2013; Lockwood, 2010). PA management can be seen as technical activity on a lower hierarchical subsystem level, depending on governance for context and direction, suggesting management cannot be effective without good governance (Nkhata & Breen, 2010). Ideally, however, governance and management efforts are coupled, providing feedback in both directions and providing resilience and adaptability for the PA (Nkhata & McCool, 2012).

The IUCN created a system of management categories for planning, establishment and management of PAs—now widely used—that relate to the management objectives and provide an internationally applicable framework for describing and designing PAs: 1a) Strict nature reserves, 1b) Wilderness areas, 2) National parks, 3) National monuments, 4) Habitat protection areas, 5) Landscape protection areas and 6) Sustainable use protection areas (Dudley, 2008). Management categories provide guidance in the form of a primary objective, additional objectives, distinguishing features, role in the landscape and compatible actions for each category (ibid). Management categories have had a significant impact for international and national policies and legislation as countries have aligned their national PA systems towards the various objectives of the Convention on Biological Diversity (CBD), and global databases by the United Nations (UN) and CBD use the classification for reporting of progress (Borrini-Feyerabend et al., 2013). Management approaches describe the focus of management efforts, often connected to the management category, and can be summarised as exclusionary (e.g.

strict nature reserves), integrative (e.g. PAs with a long history of human interaction), rights-based (e.g. areas with Indigenous peoples) and adaptive (e.g. PAs facing rapid changes) (Dudley, 2008).

Despite a rapid PA expansion and growing literature for good governance and effective management, global biodiversity is still declining rapidly (IPBES, 2019). PAs face several complex, intertwined challenges such as land use change, exploitation of natural resources, climate change, invasive alien species, human conflicts and lack of funding (Díaz et al., 2019; Hoffmann, 2022). Some of these factors however take place on a global scale and are difficult to address by individual PAs, e.g. changing weather patterns and shifting habitats and species boundaries due to climate change (Parks et al., 2022). Within the scope of PAs, there are two main solutions: increasing management effectiveness and sustainable use of existing PAs so they provide better biodiversity conservation and social outcomes within their area, and extending the global PA estate to cover larger areas. The KM-GBF goal on 30% land/sea coverage targets both of these pathways with an additional emphasis on restoration of degraded and altered lands (CBD, 2022). Furthermore, some scientists have proposed protecting 50% of land/sea by 2050 as the next goal to halt biodiversity loss and climate change, which would entail major land use changes and socio-economic impacts (Dinerstein et al., 2020; Dinerstein et al., 2017).

Research into management effectiveness began already in 1990s, when studies started to focus on the quality of PAs and the term 'paper park' was coined, describing a PA where "experts believe current protection activities are insufficient to halt degradation" (Dudley & Stolton, 1999, p. 7; McNeely, 1993). The first PA management effectiveness (PAME) framework was published in 2000, followed by various methodologies and assessment tools (Hockings, 2003; Hockings et al., 2014; Hockings et al., 2006; Leverington et al., 2010). The PAME framework describes six steps in a cycle of evaluation: 1) Context—current status of the PA, 2) Planning—how to get to targets, 3) Inputs—what is needed?, 4) Process—how is management organised, 5) Output—delivery of services and 6) Outcomes—assessment of achieved targets (Hockings et al., 2006). The Global Database on Protected Area Management Effectiveness (GD-PAME) was established in 2006 as a global platform for reporting on PAME processes and is used by international conventions and platforms such as the CBD, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) reports and the Protected Planet platform (UNEP-WCMC, 2017). Global reviews on management effectiveness indicate large scale weaknesses and shortcomings in PA management, often related to funding, socio-economic impacts and measurement of outcomes (Leverington et al., 2010; Watson et al., 2014).

In addition to the challenges raised by PAME assessments, some aspects of the assessment processes and GD-PAME have also been criticised: e.g. lacking comparability between the methods and subjectiveness and partialness of the

evaluations; concluding that the GD-PAME does not currently properly measure management effectiveness (Coad et al., 2015; UNEP-WCMC and IUCN, 2022). A recent update to GD-PAME tries to address some of these points by adding a set of standardised management effectiveness questions to the entries (UNEP-WCMC, 2025).

1.4 Sustainability as a broader goal for PAs

Early discussions regarding the sustainable use of resources in the PAs started in connection with the 1980 World Conservation Strategy, where the IUCN referred to integration of the three sustainability domains: environmental, social and economic (IUCN et al., 1980; Purvis et al., 2019). The 1982 World Parks Congress stated "protected areas in developing countries will survive only insofar as they address human concerns" (Western, 1989, p. 134). The Brundtland Commission called for integrating conservation with sustainable economic development in the 1987 report on sustainable development (Brundtland, 1987). The 1992 World Parks Congress called for win-win combinations, encouraging sustainable human use as a way to enable conservation (Brandon et al., 1998). These developments culminated in 1992 at the United Nations Conference on Environment and Development (UNCED), where the Convention for Biological Diversity was drafted with three primary objectives: conservation of biological diversity, sustainable use of resources, and fair and equitable sharing of benefits arising from genetic resources (CBD, n.d.; Naughton-Treves et al., 2005). The UN Sustainable Development Goals (SDG) represent the current global framework of 17 interconnected socio-economic and environmental sustainability goals for 2030 (UN, 2015). PAs have been identified to contribute towards 11 SDGs using an ES approach (Dudley et al., 2022; Kettunen et al., 2021; Mulligan et al., n.d.).

PAs contain many of the world's best preserved and richest ecosystems, and sustainability or sustainable use of resources in the PAs has been an important research topic and point of contention throughout recent history (McNeely, 2020). PA sustainability depends on good governance, positive socio-economic impacts and the ability to produce measurable environmental impacts (Oldekop et al., 2016; Watson et al., 2014). There is still a critical lack of data on whether conservation and socio-economic development are reconcilable; however, some synergies correlate with empowerment of the local communities in PA planning and decision-making (Gatiso et al., 2022; Naidoo et al., 2019). Valuation of ecosystems services has emerged as one strategy for the PAs to understand the importance of healthy ecosystems, their value for people and the costs of nature degradation (Watson et al., 2014; Willemen et al., 2013).

Child (2014) describes this as an efficiency equation, how can PAs maximise social and economic benefits with the constraint that the health of ecosystems is maintained? While PAs may seem like economic 'black holes' in the otherwise productive landscapes to many policymakers, Child (ibid) argues that it is difficult to find a PA where the costs would exceed the benefits and the "greatest return on investment lies in making the economic case for protected areas to society, and in maximising the

reinvestment of this value in effective management and local people" (ibid, p.470). To achieve this, new tools and strategies are needed to create conditions for positive economic and social impacts, and ways to evaluate them (Stolton et al., 2021a).

Recreation and tourism are primary economic activities in most PAs (Buckley, 2011; Spenceley et al., 2017). Tourism can provide economic opportunities aligning with nature conservation and sustainable development, but on the other hand also presents a major management challenge for many PAs (Leung et al., 2018). Concessions are policy instruments that have been developed to regulate tourism and provide a fair and transparent way of distributing social and economic benefits (Spenceley et al., 2016; Thompson et al., 2014). Different methods have also been developed to calculate socio-economic impacts from PAs for comparisons, policy and management purposes (Chidakel et al., 2021; Heagney et al., 2015; Jones et al., 2020; Kronenberg & Fuchs, 2021; Majewski et al., 2025; Mayer & Woltering, 2018; Stynes, 2005; Woodhouse et al., 2018). CBD and IUCN-WCPA (IUCN World Commission on Protected Areas) highlight the importance of developing economic impact evaluation methods for decision-making and public engagement for PAs (Stolton et al., 2021b). Political ecologists on the other hand have warned about the commodification PAs for economic interests and point out that while tourism can provide benefits locally, globally, effects for biodiversity are strongly negative (Buckley et al., 2025; Buckley et al., 2026).

1.5 Iceland's PAs and key management challenges

Iceland is an island state, sparsely populated with ca. 390,000 people in the North-Atlantic, bordering the Arctic Circle with primarily cold maritime and sub-Arctic climates, and known for its volcanic origins and frequent volcanic activity (Arnalds et al., 2023; Statistics Iceland, 2026). Figure 2 illustrates Iceland's current PA estate, covering ca. 130 terrestrial sites or slightly over 20% of the land area, and the government has committed to the KM-GBF targets for 2030 (Government of Iceland, 2022, 2025). Governance of the Icelandic PA system is diverse, stemming from various attempts to secure local legitimacy instead of applying the general Nature Conservation Act (NCA) to all sites (Icelandic Parliament, 2013; Petursson et al., 2016). The Icelandic PA system is aligned with the IUCN management categories and Iceland partakes in several international agreements in addition to the CBD, such as the Ramsar-, Bern- and European Landscape Conventions (Government of Iceland, 2022). The last 30 years have marked the creation of several large sites such as the Breiðafjörður, Guðlaugstungur and Þjórsárver Nature Reserves (NR) as well as two new NPs, Vatnajökull and Snæfellsjökull. Vatnajökull NP is a particular example due its size—almost 2/3 of the entire PA estate—its legally-binding role in regional socio-economic development and its co-management governance model (Petursson & Kristofersson, 2021; Vatnajökull National Park, n.d.). The Surtsey NR and Vatnajökull and Þingvellir NPs have also been recognised as World Heritage Sites (WHS) (The Icelandic National Commission for UNESCO, n.d.).

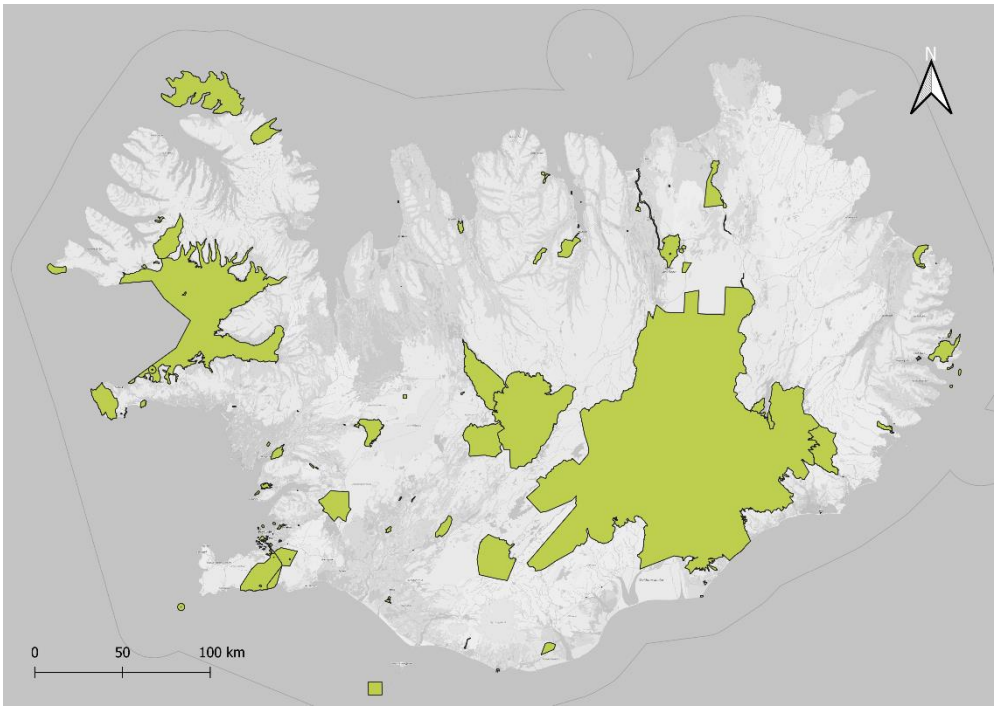


Figure 2. Map of protected areas in Iceland; GIS-data (Umhverfis- og orkustofnun, n.d.)

Several government agencies have roles in PA management in Iceland. Nature Conservation Agency of Iceland, formed January 1st 2025 as a merger of the Environment Agency and Vatnajökull NP, manages most PAs in Iceland except for Þingvellir NP and the Breiðafjörður NR, which are managed by a dedicated government agency and a local administrative committee respectively (Icelandic Parliament, 1995, 2004, 2024). The Natural Science Institute of Iceland conducts research and monitoring of the Icelandic nature including the PAs and oversees the Nature Conservation Register consisting of the current and proposed PAs (Natural Science Institute of Iceland, n.d.; The Natural Science Institute of Iceland, n.d.). Iceland also adopts everyman's rights similar to the Scandinavian countries, allowing people to relatively freely enjoy lands for outdoor activities regardless of property rights even within PAs (Nature Conservation Agency of Iceland, n.d.; Øian et al., 2018).

A nature-based tourism boom—driven by Iceland's natural assets, the need for foreign exports following the financial crash of 2008, the Eyjafjallajökull volcanic eruption in 2010 and clever marketing efforts—increased the number of tourists from ca. 500,000 in 2010 to 2.2-2.3 million in recent years as illustrated by Figure 3 (Gudmundsson et al., 2010; Icelandic Tourist Board, 2026, n.d.; Tverijonaite et al., 2018). Tourism provided 37% of all Icelandic exports in 2024, and approximately 90% of the visitors state nature is the main reason for their visit (Ferðamálastofa, 2022; Icelandic Chamber of Commerce, 2025). Managing the increasing visitors in sensitive landscapes and natural sites quickly became the main management challenge for Iceland's PAs and

large socio-economic changes have affected the entire society, bringing issues related to PA governance, effectiveness and sustainability to a central role in societal debates (Hjálmarsdóttir & Óskarsson, 2025; Sæþórsdóttir et al., 2020; Sorrell & Plante, 2021; Sutherland & Stacey, 2017).

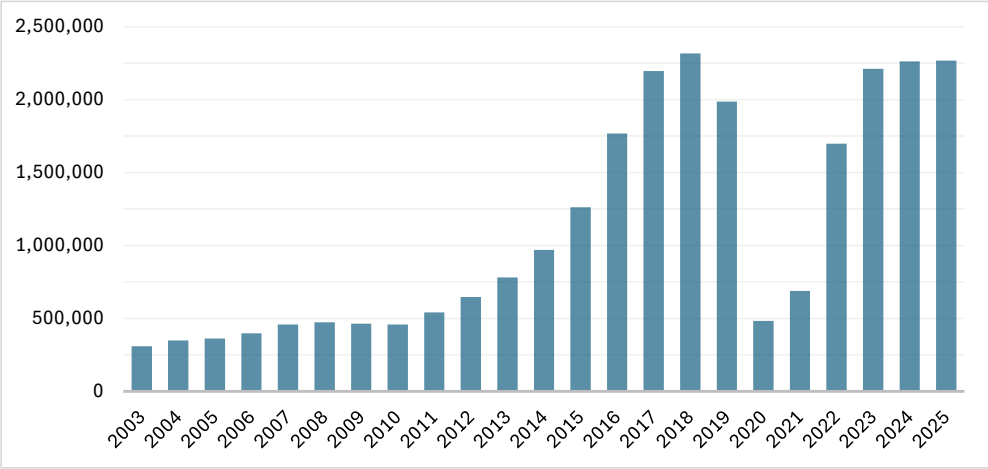


Figure 3. Departures of foreign passengers from Iceland via Keflavík Airport 2003-2025; (Icelandic Tourist Board, 2026)

1.6 Structure of the dissertation

This dissertation comprises of four connected and self-contained papers, of which three have been published. The fourth one has been submitted to an international journal for publication and is currently in review with a pre-print available. Paper I analyses the impact of governance arrangements for adaptive PA management capacity. Paper II develops a methodology to assess the economic impacts of PAs in the context of limited economic data. Paper III explores the challenges, opportunities and constraints in using concessions to regulate commercial PA tourism. Finally, Paper IV examines how sustainability and management effectiveness can be evaluated in a single framework.

This introductory chapter is written to provide a wider perspective to developments in PA governance and management, interconnections between environmental protection and socio-economic development, and an overview of the Icelandic PA system that is used in the case studies. Chapter 2 provides the dissertation's overall aims and research questions in each paper. Chapter 3 describes the methodologies and key results of each paper. Chapter 4 presents discussion on the findings of the study, academic and practical contributions, limitations and suggestions for further research. Chapter 5 draws final conclusions and policy recommendations. References and original publications are provided at the end.

2 Aims

2.1 Overall research objectives

The main objective of this dissertation is to advance the understanding of PA management by providing a broad assessment of PA governance, economic impacts, sustainability and their management implications by employing the Icelandic NPs and PAs as case studies. The study aims to contribute directly towards the KM-GBF Target 3 of effectively and equitably-managed PAs, also supporting further PA expansion efforts (CBD, 2022). Overall research questions for the individual papers are as follows:

1. What kind of impact do various governance arrangements have for adaptive PA management capacity?
2. How can we assess the economic impacts of PAs in the context of limited economic data?
3. What are the challenges, opportunities and constraints in using concessions to regulate commercial PA tourism?
4. How can PA sustainability and management effectiveness be evaluated in a single integrated framework?

The overall objective is approached from governance foundations towards an integrated sustainability evaluation. The dissertation begins with developing methods for PA governance analysis and examining how governance translates into effective management, providing the analytical and conceptual foundation. The dissertation then develops on analytical methods to assess the impact of PA tourism to the local and national economies, providing socio-economic data for policymaking, implementation of economic instruments and sustainability evaluations. The dissertation further investigates how economic instruments, particularly concessions, can be used as a management tool as well as supporting sustainable PA management and socio-economic development. Finally, the dissertation employs a pilot-study of the IUCN Green List in the Icelandic NPs to integrate the governance, socio-economic and environmental perspectives and analyse PA management effectiveness and sustainability holistically.

2.2 Research questions in individual papers

The aims and individual research questions for each original paper are presented below.

Paper I: Diversity in Protected Area Governance and Its Implications for Management: An Institutional Analysis of Selected Parks in Iceland

The paper develops Vatn's (2015) environmental governance system (EGS) framework to include the historical trajectories in institutional analysis. The study provides five case studies from Iceland's PAs to advance understanding of PAs as governance systems, how governance diversity manifests in different systems and what implications it has on their performance. The following research questions are explored:

1. What are the evolutionary trajectories of the selected PAs and factors shaping their governance systems? What can we learn from these processes for future PAs?
2. What are the attributes of the different PA governance systems and how do they compare?
3. What are the management implications of the different governance systems, using nature-based tourism as a key analytical variable?
4. What are the policy implications of the findings?

Paper II: Evaluating economic impacts of protected areas in contexts with limited data; the case of three national parks in Iceland

The main objective of this paper is to advance understanding of the economic impacts related to PAs in the context of limited data availability. The study develops an adapted methodology that supports informed decision-making on the local and national level through a case study of the three Icelandic NPs. The methodological guidelines and discussion are relevant in the wider context for researchers, practitioners and policy makers who are adapting general economic impact methodologies to their datasets in other states. The following research questions are pursued:

1. What is understood by local and national economic impacts of PAs?
2. How can the internationally used Money Generation Method 2 methodology be adapted for the Icelandic context, taking into consideration local tourism travel patterns and local economic data?
3. What are the economic impacts of NPs in Iceland?

Paper III: Developing Economic Policy Instruments for Tourism Management in Protected Areas

The overall objective of this paper is to address the research gap on the challenges, opportunities and constraints of concessions in PAs, and provide policy recommendations for introducing concessions as a tourism management tool in PAs. The study uses the three Icelandic NPs as a case study to answer the following research questions:

1. What challenges are associated with the management of commercial activities using concessions in the PAs?
2. What are the opportunities and constraints of the application of concessions in the PAs?
3. What policy implications can be drawn from the study to address the challenges in implementing concessions in the PAs?

Paper IV: Challenges in achieving a global standard for protected area management effectiveness in the context of sustainability: analysis of the IUCN Green List

In the context of the KM-GBF, this paper focuses on improving management effectiveness and PA sustainability. The study tests a pre-release version of the IUCN Green List self-assessment tool, employed by park managers of the three Icelandic NPs, to provide a deeper understanding of sustainability in a PA context and insights for improved management effectiveness using the IUCN Green List. The study aims to answer the following research questions:

1. How does the IUCN Green List Standard and the self-assessment tool contribute towards PA management effectiveness?
2. How suitable is the IUCN Green List as a sustainability standard for PAs?

3 Materials, Methods and Key Results

This section provides a summary on the methodology and main results of each individual paper to provide a necessary context for discussion. Original publications are provided at the end of the dissertation for full details.

3.1 Paper I

Paper I provides an institutional analysis of the selected Icelandic PA governance systems and their capacity to respond to changes driven by the increasing tourism pressure. The paper builds on Vatn's (2015) EGS-framework to analyse the historical trajectories of PA establishment, governance system attributes, interactions and outcomes. The paper employs a comparative case study of five Icelandic PAs, each with a different governance set up (year of establishment): Þingvellir NP (1930), Mývatn-Laxá Conservation Area (CA) (1974), Breiðafjörður NR (1995), Snæfellsjökull NP (2001) and Vatnajökull NP (2007). Figure 4 illustrates the PA locations and sizes.

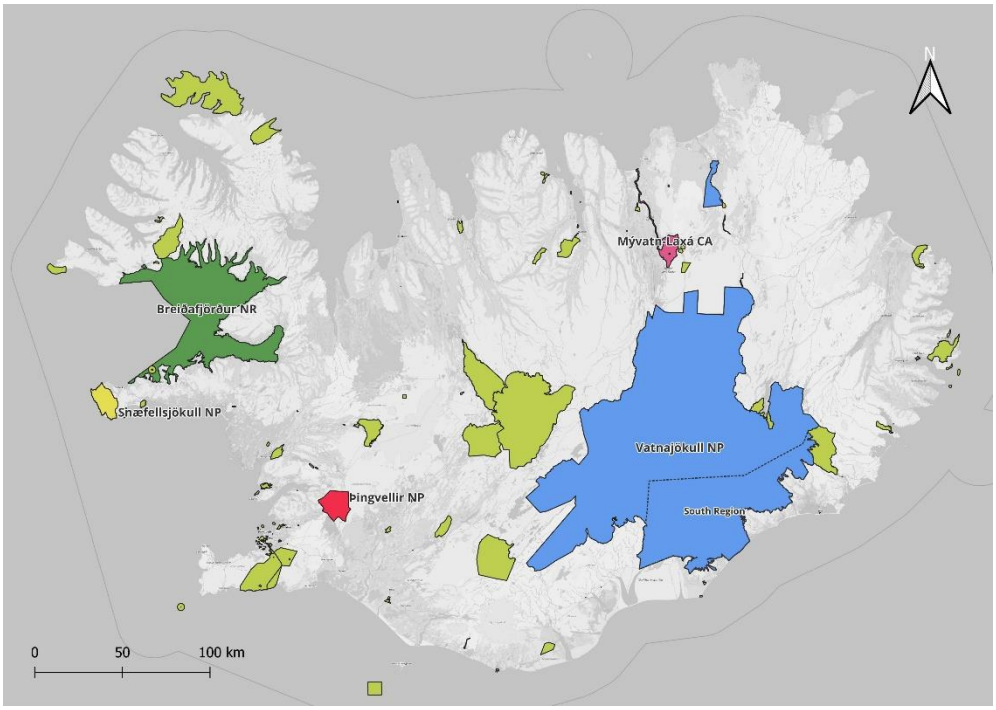


Figure 4. Map of Iceland's PAs (excluding offshore marine) with case study sites highlighted; GIS-data (Umhverfis- og orkustofnun, n.d.)

First, a narrative literature review following Green et al. (2006) was conducted to understand the historical trajectory of each PA, including original reasons for conservation, key drivers and stakeholders and potential conflicts and supporting factors. An institutional analysis was then conducted based on the laws, regulatory frameworks and governance structures of the PAs; followed by a content analysis of the management plans to identify management tools, strategies and potential need or capacity gaps. Figure 5 presents the EGS-framework used in the analysis. The main analytical concepts include input legitimacy (stakeholder participation and representation), output legitimacy (effectiveness, problem-solving capacity and adaptation), spatial fit (alignment with the natural system attributes), temporal fit (ability to respond in timely manner), functional fit (covering all ecosystem attributes and needs) and interplay (horizontal and vertical actor relations) (Ekstrom & Young, 2009; Young, 2002; Young et al., 2008).

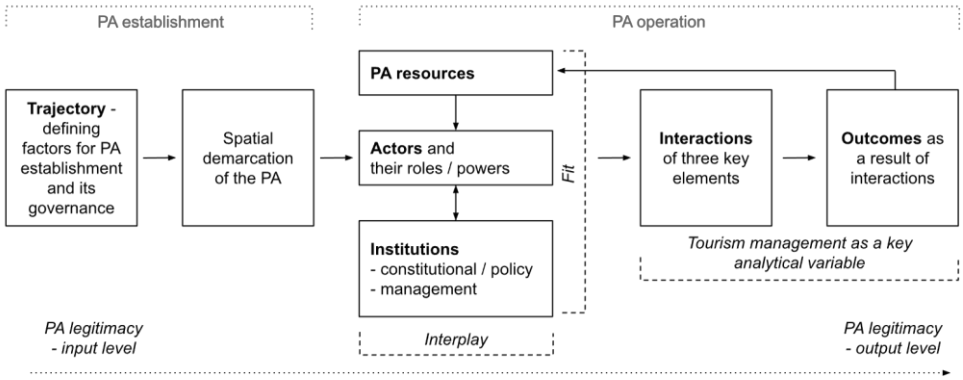


Figure 5. Environmental governance system (EGS) framework; Vatn (2015), Siltanen et al. (2022)

The institutional analysis was supplemented by semi-structured expert interviews of the PA directors, managers or head wardens of four PAs; Breiðafjörður NR was excluded due to lack of formal PA staff. The interviews were conducted on Microsoft Teams in English, recorded and transcribed. Questions in the interview guide focused on available legal tools and use of the management plan for effective tourism management, key stakeholder interactions and on potential needs for legal or administrative reforms. The participants were informed beforehand about the consent for recording, use of the data in the study and anonymity of the references in the paper.

The results of the comparative institutional analysis point out substantial diversity in the governance systems, institutional structures and legal frameworks, originating from the context-specific negotiation processes and power dynamics during each PA's establishment. In each case, these local models generally have been able to adapt to management challenges with different approaches emphasising that there are indeed no panaceas in PA management (Ostrom, 2007). However, this context-sensitive

approach can result in an uncoordinated response to management challenges, e.g. each PA having its own rules for visitors can create a confusing visitor experience, and scattered capacity between different actors and agencies.

Vatnajökull NP, with its co-management model, was found to be the most adaptive, having high legitimacy and piloting new regulatory updates and models to manage tourism activities within the PA. Snæfellsjökull NP has been able to utilise the general NCA without site-specific legislation for successful tourism management (Icelandic Parliament, 2013). Though the NCA is based on a centrally-managed approach, it accommodates local advisory committees, to which the PA has devolved significant decision-making power. Together with a low-conflict environment and local champions, Snæfellsjökull NP has very high legitimacy and provides a good example how the NCA can be extended to resemble a co-managed PA. Þingvellir NP's historical roots as the birthplace of the nation and the first PA in Iceland produced a unique centralised model with a parliamentary committee as the decision-making body and an independent government agency operating the PA. This provides very short command lines and effective responses to management challenges, but the institutional setup only allows for informal approaches to stakeholder interactions. Mývatn-Laxá CA was found to have necessary legal and regulatory tools to manage tourism pressures after recent updates but had difficulties in implementing and renewing its management plan with the stakeholders. This could be due to unclear roles and responsibilities, where an inclusive approach was taken to consult a wide range of stakeholders within a centrally-managed institutional setup. Breiðafjörður NR is a very interesting case as Iceland's only community-led PA. It has suffered from being disconnected from the other actors in Icelandic PA management and has been characterised by low management capacity due to minimal funding and staffing and slow implementation, though locally it has high legitimacy.

The results from the institutional analysis led to several observations. Adaptive capacity of the different models suggested that governance diversity can be a strength and is particularly important for input legitimacy. This is a critical observation as nations are working on increasing the PA estate in an inclusive and fair way towards the KM-GBF goals. More examples of different kinds of functional and effective institutional setups are needed as more PAs (and OECMs) are community-, indigenous-, privately- or co-managed. Coordination between a variety of governance models can be enhanced by joint policy frameworks, a shared vision for the country's PAs across various actors, and as suggested in the case of Iceland, a merger of the state PA agencies.

3.2 Paper II

Paper II provides an economic impact analysis of the tourism activities in the three Icelandic NPs: Þingvellir, Snæfellsjökull and Vatnajökull. In Vatnajökull NP, and the analysis focuses on the southern region where most of the tourism activity is concentrated, see Figure 4. The paper's main contribution is a methodological description on how to adapt the Money Generation Method 2 (MGM2) (Stynes, 2005; Stynes et al., 2000) into localised contexts characterised by limited economic data, such as Iceland's sparsely populated countryside in the case study. Figure 6 provides a simplified equation describing the general methodology. MGM2 is one of the methods used and developed earlier by the US Park Service to calculate economic contributions of its NPs and was adapted for example in Finland and Brazil (Finnish Forest Research Institute, 2009; Flyr et al., 2025; Koontz et al., 2017; Souza et al., 2019).

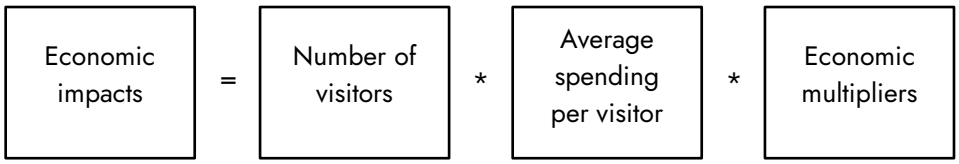


Figure 6. Simplified equation to calculate economic impacts (Stynes et al., 2000)

The paper provides recommendations on how to accommodate unique visitor travel patterns as most travellers in Iceland generally travel by car and often visit several nature-sites within one day, contrary to typical visitor behaviour of spending one or multiple days within one PA. The methodology introduced in the paper calculates economic impacts on two levels: local impacts within a 50 km radius from the PA location typically evaluated with MGM2-related methodologies (Stynes, 1999), and national economic impacts. PA economic impact analyses are generally focused on benefits for the local stakeholders; however, in Iceland the national context is relevant due to three reasons. First, the rapid car-based movement of visitors often goes much beyond the 50 km radius, potentially visiting several PAs in one day, hence the multi-destination aspect. Second, as most services are based around the capital region and Keflavik international airport, visitors can only purchase many services they need for the trip from these areas indirectly supporting PA visitation. Finally, due to the macroeconomic importance of nature-based tourism is Iceland, it is relevant to assess national economic impacts, e.g. jobs generated due to the services initially purchased 'for the trip' as well as the related tax revenue that the state can assign for the PAs later. (Siltanen, 2018)

The datasets needed for the MGM2-based analysis include reliable visitor statistics (e.g. provided by automatic visitor counters), visitor spending by category (Kajala et al., 2007; Spenceley et al., 2021), regionalised input-output (I-O) tables describing the relationship between different industries in the local economy (Kumar & Hussain,

2014), and localised employment multipliers linking visitor spending to the number of jobs created. Spending surveys register how much money visitors use in a 24-hour period on various goods and services by spending category, i.e. direct effects. Use of I-O tables allows the calculation of indirect spending effects (Type I multipliers), which describe businesses buying goods and services from other businesses to produce a service for a visitor; furthermore, induced effects describe the impact of local employees using their salaries for household consumption (Type II multipliers) (Stynes, 2005).

In the case study, PA visitor numbers were provided by long-term vehicle counters that are regularly calibrated (Þórhallsdóttir & Ólafsson, 2017). Paper II was prepared in 2022, when the latest available annual visitor statistics were from 2021 and still affected by the COVID-19 pandemic. Thus, it was decided to use annual visitor numbers from 2019 as a reference year before the pandemic. As Figure 3 shows, the year 2019 was a relevant baseline as the visitor numbers have been consistent, if only slightly higher than 2019, since the pandemic.

Visitor spending data was collected via non-probability convenience sampling primarily with an onsite electronic survey; part of the dataset was collected in 2022 for this study to include new sites or increase statistical validity, and part of the dataset was used from related research projects in 2016 and 2018 using the same survey. All spending data was adjusted to 2019 prices with the consumer price index to coincide with the visitor numbers. Final visitor spending sample (N=2,087) included only completed, valid surveys with sample sizes for individual sites varying between 501-1,005; statistically valid at the 95% confidence interval (Dillman, 2011; Oribhabor & Anyanwu, 2019). Visitor spending data for Snæfellsjökull NP was collected approximately half-and-half in winter and summer, while the data for the other sites was only collected during summer. This produces some uncertainly in the results, though the data from Snæfellsjökull showed that during winter, the visitors spend less time in the PA but used more money during the shorter visit, so the effect of the season seemed not to have a major impact on the overall spending. Finally, multi-destination spending was adapted to the Icelandic context from literature (Huhtala et al., 2010; Loomis & Caughlan, 2006; Stynes et al., 2000): if the PA was the only or most important destination for the day, 100% of the spending was included in economic analysis. For multiple site visits on one day, the PA received the percentage share by division of total number of visited sites. Non-planned visits were excluded from the economic analysis as there was no prior intention to visit the site.

Economic data for the analysis was retrieved from public databases. Domestic Type B I-O table for Iceland for year 2018, most recent at the time, was retrieved from the Organisation for Economic Co-operation and Development database (OECD, 2022). Like most countries, Iceland does not produce regional I-O tables due to time and cost implications, so the national table needed to be regionalised using a non-survey

method (Flegg & Tohmo, 2013). The Flegg Location Quotient (FLQ) method was chosen based on recommendations in the literature, use in similar contexts and availability of suitable data (Flegg & Tohmo, 2016; Kronenberg & Fredman, 2022; Vatanen & Lajala, 2019). Type I economic multipliers were then calculated from a Leontief inverse matrix from the regional transaction table as a sum of sectoral purchase coefficients (Hewings, 1985). As the Icelandic I-O table did not separate salaries from the value-added, it was not possible to calculate the Type II induced effect multipliers. The Icelandic Labour Force Survey provided the necessary municipal employment data to scale down sectoral coefficients and accommodate for imports (Hagstofa, 2022). Capture rates were calculated and applied for each spending category to account for revenues leaked abroad due to imports.

Employment multipliers were created from value added tax (VAT) -corrected company turnovers for each industry, divided by the number of full-time and all employees in each industry, giving an indicative multiplier for how the number of jobs in a sector increases with the companies' turnover. These multipliers were calculated on a national level as confidentiality does not allow such data to be released on a municipal level. Finally, tax revenues related to the spending effects from sales, income, payroll and capital gain taxes were calculated based on information from the Icelandic Tax Authority (Icelandic Tax Authority, 2022, n.d.).

Visitors spent on average $113 per day in connection with the NP visits, varying in the range of $70-154 between Þingvellir and Vatnajökull mainly due to the differences in the multi-destination behaviour. Visitors spent 45% of their total spending locally around Snæfellsjökull NP, and 51% around Vatnajökull NP. The results of the economic impact analysis are summarised in Table 1. In monetary terms, local impacts varied between $14-56MM for Snæfellsjökull and Vatnajökull, and total impacts respectively between $30-99MM with Þingvellir in the middle with $56MM. Total tax revenues generated varied between $15-46MM. As the economic impacts are strongly connected with the visitor numbers, they are provided for reference in Table 1. However, visitor behaviour and available services naturally impact these numbers.

Table 1. Summary of economic impacts[1] in the three national parks (Siltanen et al., 2023)

Site	Visitors (2019)	Local jobs	Total jobs	Local economic impact	Total economic impact	Total tax revenue
Snæfellsjökull NP	410,991	174	347	$14MM	$30MM	$15MM
Vatnajökull NP (South region)	935,572	681	1140	$56MM	$99MM	$46MM
Þingvellir NP	1,336,712	n/a	656	n/a	$56MM	$27MM

In terms of jobs, the results show Snæfellsjökull and South region of Vatnajökull NP generating locally 174 and 681 jobs respectively, representing 6% and 36% of the workforce in the surrounding municipalities. Since Þingvellir is within the 50 km radius of the capital region and nearly all services for the PA visits are purchased from the capital, it was not feasible to exclude the effect of the capital area from the total of 656 jobs, and thus local figures are not calculated. Total jobs were roughly double of the local number for Snæfellsjökull and Vatnajökull. It should be noted that if visitors do not spend money on an item or experience, it is not registered by the methodology; thus, the results largely exclude government jobs in PA management as the Icelandic NPs do not charge for example entrance fees, only parking or service fees.

In terms of methodological robustness, the results are encouraging. The analysis is based on foundations following recommendations: statistically significant primary data from visitors and visitor counters, publicly available official statistics and combined with well-documented processes. Direct comparisons to Icelandic economic data are difficult, as to the best of the author's knowledge, this is the first time I-O tables have been regionalised in Iceland. However, comparing the sectoral and employment multipliers produced by the methodology to general multipliers (Spenceley et al., 2021), or similar studies from Finland, Sweden and Spain, they were within a similar range and often closely aligned (Kronenberg & Fredman, 2022; Martin Barroso et al., 2022; Vatanen & Lajala, 2019). Comparison to the default multipliers in the original MGM2 model showed that the job multipliers based on the US economy were higher than their European counterparts. The localisation of the methodology demonstrated that an earlier study using conservative default multipliers from the MGM2 model overestimated the job impacts though economic impacts were similar and highlights the importance of primary data and localised economic models (e.g. I-O tables) (Siltanen,

[1] Definitions: jobs include part-time jobs; monetary economic impacts include direct and indirect effects (exc. induced), given in million USD; currency conversion based on Central Bank of Iceland official exchange rate of Dec 7th, 2022: 1 USD = 141.23 ISK.

2018; Stynes et al., 2000). The employment impacts of this study were also in line with general tourism employment statistics from the Icelandic Travel Industry Association (SAF, 2023). The FLQ-method allows for multiple ways to regionalise the national I-O tables, and thus it can be used in a variety of contexts based on available data (Flegg & Tohmo, 2016).

3.3 Paper III

Paper III analyses concessions as economic instruments in the three Icelandic NPs: Þingvellir, Snæfellsjökull and Vatnajökull (Figure 4). The legal framework for concession agreements has been recently established in Iceland, and a recently enacted Commercial Use Act (CUA) from the Ministry of Finance includes legally-binding obligations for the PAs to regulate commercial tourism activities on state-owned lands (Icelandic Parliament, 2021). Paper III reviews how the legal framework is currently used and employs stakeholder interviews to identify the challenges, opportunities and constraints in the NPs. Concession classification from Spenceley et al. (2017) was used, which describes four levels of legal instruments: permits, licences, leases or management contracts, and (large-scale) concessions.

First, a review of laws, regulations and policies concerning concessions was carried out. Laws and regulations are available in government portals and employment policies on the NP websites. A summary of all regulated business activities was compiled based on the information from the PA websites and government portals regarding agreements that fit the four categories. Complete data was verified by communication with respective PA managers. Second, interview requests were sent to all PA managers involved in preparing, processing and monitoring regulated business activities, as well as to managers in these businesses operating under different concession arrangements. The objective was to elicit perspectives both from the regulatory and business stakeholders. The process was a combination of purposive and snowball sampling and achieved a 40.4% response rate with 21 respondents. Informed consent was obtained from all participants, and the interviews were conducted in English via Microsoft Teams using a semi-structured interview guide, and these were then transcribed. Top-down elaborative coding was used with three analytical rounds (Auerbach & Silverstein, 2003).

The results of the study show that Iceland has a comprehensive legal framework for concessions with practical examples in all levels of the classification (Spenceley et al., 2017). Currently, the implementation process is still in the initial stage and uneven, only applied for some business activities contrary to the obligations in the CUA. Stakeholder support from the PA managers and businesses to using concessions was strong with both sides quoting improvements in environmental protection, visitor safety and experience. However, stakeholder perspectives varied more regarding the challenges. PA authorities lacked the necessary workforce to manage and enforce regulations,

while businesses found short contracts—often only one year—a hindrance to business planning and having to fit in the frame of the contracts to stifle innovation in some cases. Table 2 provides a summary of opportunities and constraints identified across all concession types.

Most respondents (76%) saw concessions as an opportunity to fund PA infrastructure and staffing, and businesses generally agreed with the need to regulate limited resources and pay for the use of public lands. The NCA allows PAs to collect and retain service fees for service provision, while the CUA directs concession payments to the national treasury, further distributed at the discretion of the Ministry of Finance. The criteria for evaluating tenders for concessions is primarily based on the price offer, which was seen as a constraint both by the PAs and businesses due to the social impact implications. Most local companies are small and have great difficulty in competing for price offers with large, often foreign-funded companies from the capital region. However, favouring businesses for example based on location would violate general administrative law. While only Vatnajökull NP's legal framework and employment policy require the PA to support local livelihoods, this topic was brought up by companies at all NPs. Concession contracts forcing out local operators is an internationally recognised issue and there are no simple solutions (Dinica, 2017). Respondents preferred using per-visitor fees or licences to scale costs between different-sized companies and suggested breaking large-scale concessions into smaller opportunities so a wider range of companies could submit offers. This would also limit risks in transferring contracts and over-reliance on one service provider in case of non-conformance, but at same time complicate concession management.

Overall, the concession system was seen to lack a holistic sustainability perspective and a functional way to balance between economic, environmental and social criteria. Differences and ambiguities between national and site-specific laws and policies hindered implementation and called for legal clarifications and guidance, national policies and better communication between the actors.

Table 2. Summary of opportunities and constraints for concessions (Siltanen et al., 2026b)

Opportunities	Constraints
Large-scale concessions	
• Means to build needed infrastructure where government would not invest. • Business opportunities. • Concession fees can provide significant funding for PAs. • Splitting large-scale concessions to manage PA risk and provide opportunities for a larger number of companies.	• Monetary focus for tender criteria in the CUA, and interpretation between PA-specific laws unclear. • Smaller companies cannot partake in tenders. • Large-scale concessions are a risk for the PA in case of non-conformance. • Current concession contracts provide limited funding for the PAs.
Leases / management contracts	
• Means to provide services and infrastructure outside of PA interests. • Terms of the contracts can be used to steer businesses for higher environmental standards.	• Contracts currently issued have too short timeframes for the companies.
Licences	
• Opportunity to regulate areas designated for commercial activities while protecting the rest. • Requirements have increased service quality, visitor experience and safety. • Provide a holistic picture of commercial activities in the PA. • Threat of non-renewal can function as a deterrent for violations.	• Currently issued mostly annually, lack of foresight for companies and cumbersome for the PA. • Current implementation limited in scope; unequal for companies. • Licences are issued for a nominal processing fee, no income for PAs. • Lack of workforce and enforcement mechanism for efficient monitoring.
Permits	
• Per person fees for permits seen as a fair approach for everyone. • Provides control of activities and PA funding. • Issuing a limited number of permits could provide means for regulating capped activities without having to tender large-scale concessions.	• According to the Icelandic legal framework, fees can only apply against the costs of the activity; companies argue they are used for other purposes as well. • Lack of workforce to monitor activities requiring permits.

3.4 Paper IV

Paper IV evaluates the IUCN Green List as a global management effectiveness and sustainability standard by testing a prototype of its self-assessment tool in Iceland's three NPs Þingvellir, Snæfellsjökull and Vatnajökull (Figure 4). The KM-GBF Target 3 calls for all PAs to be effectively managed and evaluated by 2030. The IUCN launched the Green List in 2014 and officially approved the Green List Standard (GLS) in 2017 but uptake has been gradual and PAME evaluations are carried out globally with dozens of various frameworks and tools (Chen et al., 2023; Coad et al., 2015; IUCN-WCPA, 2017; Leverington et al., 2010). Only recently were standardised questions provided by GD-PAME to allow global comparisons and evaluation of the KM-GBF Target 3 from a management effectiveness perspective (UNEP-WCMC, 2025). The IUCN Green List also positions itself as the first PA sustainability standard (IUCN-WCPA, 2017), but does not go into detail in defining what it means in the PA context. This provides an opportunity to explore what sustainability means for PA managers and how it relates to management effectiveness, and whether both concepts can be evaluated using the same standard.

Iceland uses an adapted version of the Management Effectiveness Tracking Tool (METT) to assess management effectiveness at 144 sites within the PAs (Nature Conservation Agency of Iceland, 2025); PA managers did not have previous experience on using the Green List. An experiment was organised with the IUCN, including introduction and training on the GLS and access to a pre-release version of the Green List self-assessment tool. After the five participating NP managers completed the training and self-assessment exercise, semi-structured interviews were carried out. The interviews were conducted in English using Microsoft Teams, transcribed and top-down elaboratively coded using the Taquette qualitative data analysis application with two analysis rounds (Auerbach & Silverstein, 2003; Rampin & Rampin, 2021). Informed consent was obtained from all participants before the study. The process is illustrated in Figure 7.

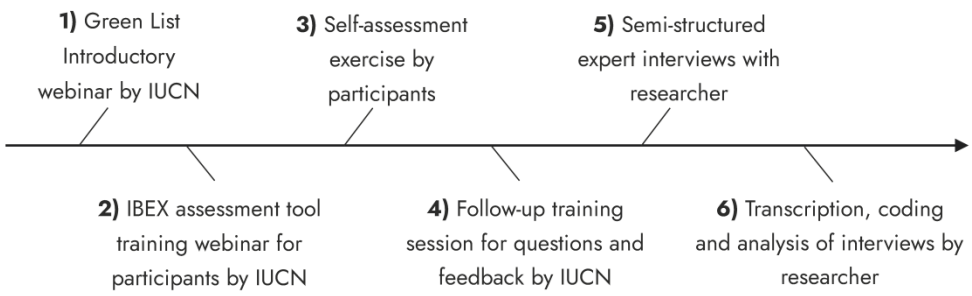


Figure 7. Step-wise methodology of the experiment in Paper IV (Siltanen et al., 2026a)

Additionally, to evaluate the Green List as a sustainability standard, the criteria in the GLS were placed on a best-match basis within the environment, socio-economic and governance (ESG) framework pillars (Lee & Abdullah, 2024), and linked to the relevant SDGs following the approach of Cook et al. (2023), see Figure 8.

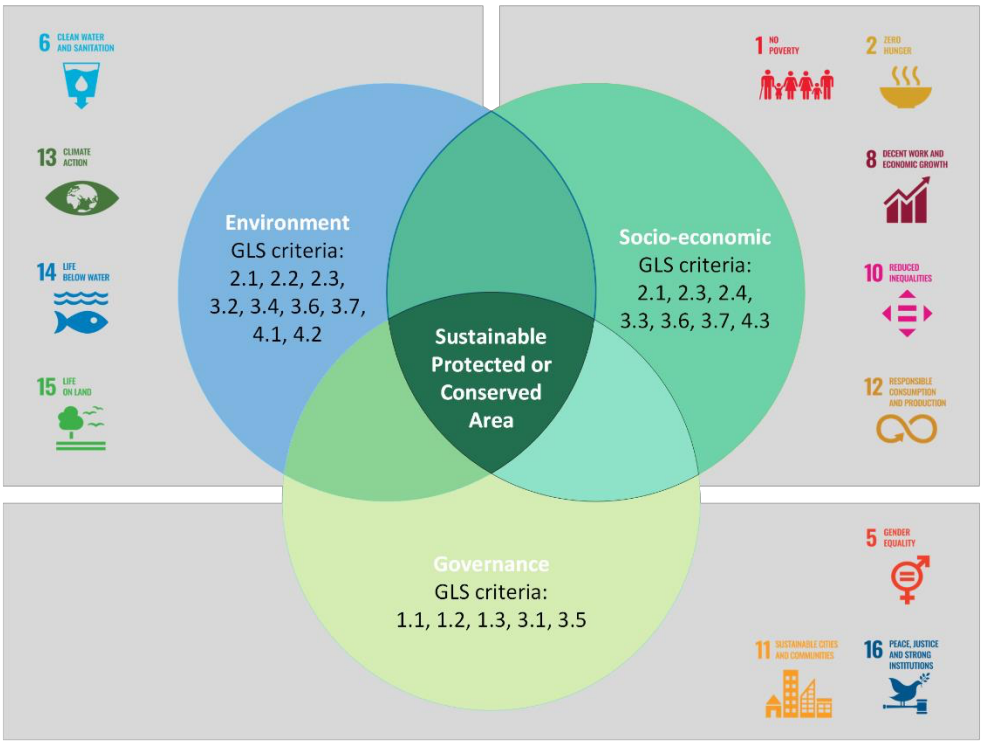


Figure 8. The IUCN Green List criteria and SDGs in a sustainability framework (Siltanen et al., 2026a)

As Figure 8 illustrates, the Green List criteria are relatively evenly distributed in the ESG-pillars, covering the main sustainability aspects in a balanced way. They also contribute to 12 out of 17 SDGs through the matching process between the GLS and the SDGs indicators and criteria, a result similar to 11 out of 17 SDGs by Kettunen et al. (2021) following an ES approach. These findings support using the Green List as a sustainability standard for the PAs and align with the IUCN's intention. However, on an individual indicator level, the Green List was found to be general and lacking in ambition in some cases. For example, according to the interviews, the Icelandic NPs seemed to be far ahead of the indicator requirements in the operational pursuit of sustainability and called for further actions for climate mitigation, while the Green List indicators only asked for an evaluation of the impacts of climate change. Similarly, the importance of socio-economic context was found to be given relatively little weight in the Green List and there was a lack of practical guidance on how to incorporate these perspectives into site management procedures.

Regarding management effectiveness, the PA managers found the Green List self-assessment tool to be both comprehensive and insightful, useful in identifying strengths and weaknesses, and particularly strong in terms of assessing governance, planning and conservation outcomes. The respondents found the tool useful for a comprehensive governance- and biodiversity-centred review, for example, with a five-year interval, while the national framework assesses incremental site-based developments annually. The Green List assessment highlighted the importance of comprehensive management plans and pointed out limited understanding of ES and assessments of ecological integrity in the Icelandic PAs. On the other hand, the Green List indicators seemed to lack direct references to geodiversity and contributions of Arctic biomes to ES and biodiversity.

Overall, the PA managers saw the assessment as a valuable international benchmark and potential reference for the national system. The Green List Standard allows for regional adaptation if needed, and this case study shows that a flexible implementation and context-sensitive evaluation may be needed. However, the Green List provides a comprehensive management effectiveness framework that is well-aligned with the KM-GBF Target 3. The self-assessment tool is a valuable addition for efforts to improve management and conservation outcomes.

4 Discussion

4.1 Main outcomes and cross-cutting themes

This Chapter synthesises the findings of the dissertation by presenting the key outcomes for the overall research questions (Chapter 2.1) and drawing together cross-cutting themes.

4.1.1 Governance outcomes

The dissertation demonstrates that adaptive PA management capacity is not necessarily dependent on the governance setup as different models in the governance analysis showed relevant adaptive capacity in responding to challenges. A co-managed NP was seen as the most adaptive in piloting new approaches and models to address challenges, but centrally-managed NPs proved also very responsive. Legitimacy was a critical factor in the establishment of all studied PAs, addressed in different ways and highlighting the need to include local stakeholders in the decision-making, supporting findings in literature (Dawson et al., 2021; Fidler et al., 2022). Resulting governance diversity was seen as a strength for legitimate, effective and locally-relevant institutional setups. Institutional analysis and the EGS-framework were found to be useful analytical tools for better understanding of the roles, powers and capacities of various actors and their interactions, operationalised by different governance setups.

The adaptations made to the EGS-framework put a stronger emphasis on understanding the local context and historical factors that shape local understanding and support for the PA, allowing actors involved in the PA establishment to better take them into account. This provides insights for designing more legitimate, adaptive and context-aware governance systems and addresses recognised challenges in implementing new collaborative governance models (Akther & Evans, 2024; Hoffmann, 2022; IPBES, 2019; Lockwood, 2010). Tanaka (2019) describes this aptly as a need to recognise the people living 'beyond the boundary' of traditional protected areas, where complex land ownership, diverse stakeholders and overlapping institutions complicate land management and call for more inclusive approaches, partnerships and soft laws. In the Japanese NPs, this is implemented by a collaborative body called *Kyougikai*, which provides the platform for participation, discussion and consensus between the stakeholders (ibid), similar to the role of the regional boards of Vatnajökull NP or the advisory committee of Snæfellsjökull NP.

4.1.2 Socio-economic outcomes

Most PA designations should also aim to improve socio-economic conditions for the local stakeholders, but this goal is often not fully realised (Gatiso et al., 2022; Järv et al., 2021). The economic value of ecosystem services from PAs is in hundreds of billions of dollars each year and could allow PAs to take a leading role in rural development (Balmford et al., 2015; McNeely, 2020). However, knowing the global impacts may not be enough to provide support for the local PA unless these results are adapted to the local context, revealing the value behind each visitor (Spenceley et al., 2021). To enable such calculations in contexts with limited economic data, the dissertation describes the process of localising the MGM2 methodology to the Icelandic context, enabling reporting of economic impacts of PAs in terms of jobs as well as monetary impacts. The results include indirect impacts of spending in the value-chain based on national I-O tables, which were regionalised using the FLQ-method. Employed in Iceland for the first time, the localised methodology proved viable and produced results aligning with studies from other Nordic countries and international recommendations. PA managers can use the results to concretise positive impacts to the local economies and improve attitudes towards conservation, make more informed decisions about tourism management and justify spending on PA management or infrastructure to secure sustainability and conservation goals (ibid).

Concessions are the primary economic instruments allowing local businesses to provide services in the PAs and contribute to local well-being; they are also used to align the commercial activities with conservation values (Spenceley et al., 2016; Spenceley et al., 2017; Thompson et al., 2014). Implementing a concession system is not simple, however, as concessions have been shown to encourage unsustainable tourism practices and there is a general lack of research on how to regulate concessions (Bryant, 2019; Dinica, 2017, 2018). To analyse an emerging concession system and its challenges, the dissertation provides an overview of the legal and regulatory framework for concessions, its current implementation, and stakeholder perspectives of the PA managers and involved businesses in Iceland. This study was carried out in the same PAs where the economic impact study had already established significant revenues from tourism activities, some regulated by the concessions under review in the subsequent study.

Overall, the study found the legal framework to be comprehensive with concessions implemented through permits, licences, leases and large-scale concession arrangements. However, the implementation was still in initial stages with only some industries in some NPs subjected to concession arrangements. Primary opportunities from concessions were related to environmental protection, improved visitor safety and experience, funding opportunities for PAs and business opportunities for communities around the PAs, reflecting common benefits in literature (Spenceley et al., 2017). Constraints were experienced in the PA capacity to manage the concessions, business

foresight to make investments due to short concession contracts owing to PA uncertainty and legal ambiguities, typical signs of an emerging regulatory system. Interestingly, social equity concerns and a lack of holistic sustainability perspective emerged as the core issues in the study; the regulatory system was seen overly focused on price-offers in the tender criteria and lacking attention on the social and environmental impacts. These findings have been reported as critical issues also from established concession systems (Brumatti & Rozendo, 2021; Dinica, 2018).

Lackey and Bricker (2022) describe how concessionaires can become champions in sustainability efforts through policy-refining, a lengthy learning progress and various motivations: firstly to fulfil contractual obligations and gain profit, but also intrinsic motivations to contribute to sustainability, a sense of community and social connections between the stakeholders. Jones et al. (2023a) present social impact as a key predictor for the level of public support for the PAs, and the perceptions of other people who live nearby in turn the key predictor for the perceived social impact, stressing the importance of these social connections. Though in early stages, many stakeholders in the Icelandic study reflected these themes in their perspectives. The local stakeholders, PAs and businesses alike, asked whose life were the concessions going to make a difference in? Will there be more children at the local school? Will the concessions help the PA to operate better and how can they enforce stricter environmental responsibilities for the concessionaires? The stakeholder perspectives contrasted with the values of the central administration—which was mostly concerned about the economic value of the concession—further emphasising the need to understand concession systems from a social foundation.

4.1.3 Management effectiveness and sustainability outcomes

Conclusions from the economic impact and concession studies underlined the need to connect the economic, social and environmental considerations together under a wider sustainability perspective. Management effectiveness frameworks already provide robust tools for measuring conservation outcomes (Dalton et al., 2024; Wells et al., 2026). As the IUCN Green List combines a management effectiveness assessment with a sustainability standard, it was chosen for a pilot study to analyse how management effectiveness and sustainability could be evaluated using a single integrated framework. The study involved all the Icelandic NPs and utilised a prototype of the IUCN Green List self-assessment tool. The PA managers found the tool thorough for benchmarking and assessing planning and conservation outcomes, and useful for gaining recognition and support from local and international stakeholders; results very similar to Wells et al. (2016). The Green List provided a deeper analysis regarding governance compared to the national management effectiveness tool and highlighted the need to further investigate conservation outcomes and ES in the Icelandic context; in other words it was effective in identifying gaps in data and existing assessments. Many studies have pointed out gaps in long-term biodiversity monitoring data and a lack of robust causal

inferences (Chen et al., 2023; Coad et al., 2015; Hoffmann, 2022). However, despite their shortcomings, management effectiveness assessments are the key tool to focus on PA quality instead of quantity (ibid).

In terms of the sustainability assessment, the Green List provided a balanced distribution of its criteria in the ESG-sustainability pillars and was linked to most of the SDGs, aligning closely with Lee and Abdullah (2024) and Dudley et al. (2022) though using different methodologies. The study affirms the Green List provides a useful tool in ensuring that PA management efforts align with sustainability. Yet the study suggested that the ambition of criteria related to climate change and socio-economic impact could be amplified. It is understandable that criteria deemed suitable for the entire global PA estate becomes somewhat generic and allowances for regional adaptation can increase the relevance—and ambition—of the Green List in different contexts. Nonetheless, given the long-standing challenges regarding social equity and emphasis on aligning the socio-economic and environmental goals (Gatiso et al., 2022; Gurney et al., 2023; Otero et al., 2020; Zhang et al., 2023), it seems that the Green List alone will not hold all the answers for reconciling these objectives. Recent studies advocate connecting top-down initiatives such as the KM-GBF and the Green List to local realities and locally-collected data (Dehmel et al., 2026; Ghoddousi et al., 2022; Múnera-Roldán et al., 2024; Rodríguez-Darias & Díaz-Rodríguez, 2023), which based on the studies presented in this dissertation, may indeed be the key for sustainability as well.

Recalling the PAME process introduced in Chapter 1.3. (Hockings et al., 2006), the studies presented in the dissertation inform all stages in the management effectiveness cycle. Governance analysis can be applied in the design stage for a better understanding of the context (1) and planning (2) that fits the needs of the PA. Analysis of the management tools and economic instruments can support assessment of the inputs (3) and processes (4). The Green List study integrates the design and management stages (1-4) with the delivery of outputs (5) and outcomes (6), while the economic impact assessment study provides tools for measuring socio-economic outcomes (6). Studies on conservation outcomes have shown that traditional management effectiveness assessments have not been enough and 'paper parks' are common (Coad et al., 2019; Díaz et al., 2019; Geldmann et al., 2015; Geldmann et al., 2019; Stewart et al., 2026). Recent advances in the management effectiveness literature are highlighting the need to separate the analysis of the management processes and ecological outcomes, use a combination of multiple tools and methodologies, provide more reliable data on ES and biodiversity through various data sources, and be able to demonstrate the causal effects and cost-effectiveness of protection interventions towards outcomes (Chen et al., 2023; Geldmann, 2023; Ghoddousi et al., 2022; Lanzas et al., 2024; Li et al., 2024).

4.1.4 Implications for PA management

These recommendations for assessing management effectiveness and conservation outcomes highlight the growing needs for diverse expertise, collaboration and availability of data, and reflect a constantly shifting baseline for PA management. For example, in the Icelandic context, the Green List study conveyed a realisation from the PA managers that though some ecological data on conservation outcomes exists, it is often located in other government agencies or research institutes, and under-utilised to inform PA management. Thus, PAs are far from being able to provide evidence on causal effects of alternative management interventions. Similarly, a lack of understanding and practical evaluation tools for Arctic ES in the PA context was identified in the study. This reflects a wider lack of studies on measuring ES in a PA context and connecting them to PA management, although reaching the KM-GBF Target 3 would notably contribute to the global ES (Pu et al., 2023; Zeng et al., 2022). The IUCN has produced guidance for ES tool selection and developed the PA-BAT+ tool to identify ES within PAs with a wide range of stakeholders and increase the understanding of the wide range of benefits from PAs (Ivanić et al., 2020; Neugarten et al., 2018). Though the PA-BAT+ is not a monetary valuation tool, it can be used to rank or compare different ES contributions (ibid). This is a good example of ways to measure social impacts and connect social values to decision-making through ES (Štrbac et al., 2022; Suich & Dawson, 2023). However, ES studies can also produce unexpected results in PAs due to data gaps and assumptions in the models (Buschke & Capitani, 2025).

Notwithstanding these limitations on measuring conservation outcomes, PAs in Iceland (and globally) are committed to the KM-GBF Target 3 and providing data on management effectiveness using currently available tools is the first step in the process. Building capacity is a long-term process, and the observations from this study suggest that it would be useful to start building formal and informal collaboration, and networks of expertise, that can support improved conservation and socio-economic outcomes in the future. The government of Iceland has indicated that it plans to provide a baseline management effectiveness analysis of all its PAs using the MEPCA indicator tool to fulfil the management effectiveness evaluation requirement in Target 3 (Government of Iceland, 2026; Singleton et al., 2024). The MEPCA tool provides an overall score of management effectiveness and can be used as a high-level reporting tool (Wells et al., 2026). In addition to the MEPCA tool, selected PAs with specialised staff and existing collaborations with research institutions could pilot more detailed management effectiveness evaluations and comparisons with management effectiveness interventions to build capacity for more informed and cost-effective PA management. New approaches such as citizen science could also the trialled in these pilots (Cheung et al., 2022; Suškevičs et al., 2024). Such efforts would build readiness for more diverse governance approaches in Iceland in the future, such as co-, locally- and privately-

managed PAs and OECMs, and strengthen the role of locals and other stakeholders as partners in PA management (Nyaupane et al., 2022).

4.1.5 Emerging needs for policy and future studies

Overall, these developments and challenges identified in the dissertation reflect the findings of Armitage et al. (2012) on emerging shared governance mechanisms, interactions of various environmental resource management systems, necessity for adaptive management, various sources of necessary knowledge (e.g. locals and scientists) and the importance of interactions of the PA managers with these stakeholders. In this evolving governance context, it is very important to understand the attitudes and factors that relate to public support towards PAs. Support for livelihoods is one aspect, as studied in different perspectives in this dissertation. Flodén and Reimerson (2023) call for a change in the discourse how government agencies engage with Indigenous and local stakeholders. Other social aspects can also be researched to better understand support and engagement towards PAs, the KM-GBF targets and beyond (Andrade et al., 2023; Fidler et al., 2022; Jones et al., 2023b; Szalast-Piwińska, 2023; Wengel et al., 2024).

In Iceland, these topics have not yet been studied systematically and such research would inform future expansion of the PA and OECM estate as well as the governance evolution (Petursson et al., 2025). A governmental study interviewed various organisations to identify perspectives on the socio-economic impacts of Icelandic PAs and could serve as a starting point (Government of Iceland, 2022). A recent study in participatory land use planning in rural Iceland revealed strong willingness to participate from the public, and similarly to this dissertation, highlighted the need to integrate social, economic and environmental considerations into the decision-making process (Ólafsdóttir et al., 2026). Letting go from the centralised legacy may be a challenge for Iceland, as was suggested in the case of Sweden (Dahlberg et al., 2010). However, existing site-specific PA arrangements signal an openness to various equitable approaches.

4.2 Academic contributions

This dissertation makes several academic contributions. Firstly, it contributes to governance system analysis by further developing the EGS-framework (Vatn, 2015). In the extended model, governance systems are placed in a historical context, setting more emphasis on the understanding of contextual factors in a way to improve legitimacy and inclusion. The results point to benefits from governance diversity and provide important nuances to the understanding of the four main governance categories traditionally described by the IUCN (Borrini-Feyerabend et al., 2013); in fact, resembling more the concept of a PA governance continuum (Franks et al., 2024, p. 18). The analysis with historical trajectories shows that governance arrangements and

management capacities change with new legal and regulatory frameworks, highlighting that governance systems are not static but evolve through interactions and emerging needs. Thus, institutional analysis should be used as a recurring tool to improve understanding and management effectiveness outcomes. The study confirms legitimacy as a central factor for PA establishment (Dawson et al., 2021; Fidler et al., 2022). The study also highlights that adaptive capacity is not tied to a single governance model, though a co-managed model was deemed the most adaptive in study.

Regarding methodologies to calculate economic impacts of PA tourism, the dissertation builds on Spenceley et al. (2021) and Stynes et al. (2000), and contributes to literature by providing a detailed account of localising the MGM2 methodology to the Icelandic context and comparing the results to similar studies elsewhere. The lack of detailed regional economic data due to cost or privacy constraints has curtailed local economic studies for a long time, but variations of the LQ-methods have provided sufficiently accurate regional data at low cost, e.g. the FLQ-method employed in this study (Flegg & Tohmo, 2019; Jensen, 1990). Travel patterns and behaviour of tourists in Iceland is also quite unique, characterised by short visits to multiple sites in one day both in and out of the PAs (Siltanen, 2018). This calls for specific guidance and adaptation of multi-destination visitor spending data and contributes to academic studies in adapting park visitation methodologies to different contexts (Job et al., 2021).

The dissertation answers the calls in literature for more studies on concessions and economic policy instruments (Dinica, 2018; Eagles, 2014; Fischer et al., 2023; Rode et al., 2016). As far as the author is aware, it is the first empirical study of an emerging concession system in the context of Nordic everyman's rights to roam. The Icelandic case study highlights challenges in using concessions to regulate booming commercial tourism with a unique dataset of comparing the perspectives of the regulatory and business stakeholders. The study reveals that many perspectives of these 'opposite' stakeholders are indeed similar and advances policy instrument theory by studying how economic and governance structures impact the implementation and effectiveness. Some challenges could be addressed with governance analysis; for example, decision-making difficulties when the beneficiaries also sit in the management boards in a co-managed PA. The results strengthen findings in the limited concession literature (Brumatti & Rozendo, 2021; Dinica, 2018; Øian et al., 2018; Roddewig, 2021), highlighting challenges with economically-focused motives and the need to integrate concessions within a wider sustainability framework to ensure alignment with environmental and social goals.

The dissertation synthesises the various calls in literature for better management effectiveness, reconciling conservation with socio-economic impacts and assessing sustainability by a pilot experiment with the IUCN Green List (Bancheva-Preslavska, 2025; Ghoddousi et al., 2022; McNeely, 2020; Wells et al., 2026). There is also limited literature so far on the application and results of implementing the IUCN Green

List (El-Hameed et al., 2024; Glatz-Jorde et al., 2020; Tanner-McAllister et al., 2024; Wells et al., 2016). The study contributes to academic literature by first reviewing how the concept of sustainability has been used in the PA management literature and linking the IUCN Green List to the ESG -sustainability pillars and SDGs through a systematic process. This affirms that the Green List provides a balanced sustainability representation as well as providing a methodological reference for further case studies and policy recommendations (Dudley et al., 2022; Kettunen et al., 2021). The study provides conceptual clarity on how sustainability indicators can be embedded in a management effectiveness framework and presents experiences using a publicly available global alternative to the locally-derived sustainability models (Lee & Abdullah, 2024; Marques et al., 2013). The results highlight a commendable alignment of the Green List to the KM-GBF policy framework and indicate that it is useful tool towards the realisation of Target 3.

4.3 Practical contributions

The dissertation features practical tools and recommendations for practitioners and policy-makers. The extended EGS framework can be used as an analytical tool to study changes in the governance structures, resources and relations between the actors. This can help identify bottlenecks or issues in legitimacy, capacity and fitness of the governance setup. The five cases analysed provide practical examples to practitioners and can assist in the analysis of other sites, as well as providing policy recommendations for Icelandic decision-makers. With the right facilitation, governance analysis could even be a tool to engage local stakeholders in the governance system design and improvement. The study used tourism management capacity as a practical variable to evaluate the fit of the governance system, pointing out both some legal gaps and effective policy instruments. Finally, variations from the classic four governance types, as described in Chapter 1.1, showed that neither legitimacy nor fit (or adaptive capacity) necessary follow from the main type, and rather it is the implementation and understanding of the context that matters. This is encouraging news for all PAs to improve on what they have, as major governance reforms are long processes.

The economic impact study provides a detailed method of localising economic data to calculate economic impacts of PAs and contributes to studies providing data on PA socio-economic contributions and recreational ES (Martin Barroso et al., 2022). The study uses the MGM2 methodology and its theoretical foundations as a starting point, but the process is generic to analyses that use I-O tables as macroeconomic data, as recently outlined and recommended by UNESCO (Spenceley et al., 2021). The study is particularly useful for practitioners in providing a step-by-step guide of the process, where the guidelines from UNESCO are more general (ibid). Documentation is also provided on the handling of specific visitor behaviours that can be used as a reference or adapted to other scenarios, as well as discussion on sensitivity analysis and comparisons to other studies to evaluate how realistic the results are. The methodology

provides a pragmatic way to contextualise economic flows from global ES studies (Balmford et al., 2015; McNeely, 2020). The Icelandic NPs' economic impacts corroborate other studies showing that PAs are not 'economic black holes' (Child, 2014), and can be used to advocate for support from the local communities and governments, funding to ensure sustainable tourism outcomes and comparisons for opportunity costs and land-use decisions (Dahlberg et al., 2010; Visconti et al., 2015).

The dissertation also offers practical guidelines and case studies for PA managers and decision-makers on designing and implementing concession systems by discussing what key stakeholders deem valuable from their perspectives, and what opportunities and constraints are involved in using different kinds of concessions. The case studies place general guidelines in a real-life context (Spenceley et al., 2017; Thompson et al., 2014; World Bank, 2021). Rapid implementation of the concession system in Iceland provides some lessons learned for other PAs in the same process, e.g. in terms of the necessary capacity needed for managing a concession system, avoiding ambiguities and gaps in the laws and regulations, having necessary means of enforcement, and aligning the concessions and associated criteria with a range of socio-economic and environmental goals. The study provides suggestions from the stakeholders on managing risks associated with large-scale concessions and levelling the playing field between different-sized businesses and enabling smaller businesses to engage in tenders.

Finally, the application of the IUCN Green List self-assessment tool gives practitioners an understanding on what they can benefit from using the Green List self-assessment tool, both for management effectiveness as well as sustainability. The study provides PA manager reflections regarding the process and benefits of becoming a certified Green List site. This was also the first study on applying the Green List in the Icelandic context, providing the Icelandic PA managers and authorities with insights on data gaps and how to improve management effectiveness that had not been raised earlier with the national assessment tool. Reflections on what sustainability meant for the PA managers may provide useful ideas and starting points for other practitioners. PA managers found the Green List to be a useful tool in communicating conservation outcomes to other stakeholders, e.g. local communities, national government or internationally, supporting finding from other studies (Bancheva-Preslavska, 2025; El-Hameed et al., 2024; Wells et al., 2016).

In summary, the dissertation provides practical recommendations, methodologies and tools towards national and global efforts of the KM-GBF Target 3 for inclusive and effectively managed PAs and also contributes towards a better understanding of the governance context for expansion of the PA estate.

4.4 Limitations

The main contributions of the dissertation are in governance, socio-economic impacts and economic instruments, and management effectiveness and sustainability. However, analysis of the conservation outcomes within management effectiveness is outside the scope of this dissertation, though indirectly addressed in the governance and management effectiveness analyses and experiments.

There are also limitations in the independent studies. For example, the governance analysis takes procedural legitimacy for granted and efficiency (ability to reach goals cost-effectively) is not analysed due to a lack of data on management costs vs. outcomes. In terms of effectiveness, the focus is on the management capacity of the governance system to address issues and conservation outcomes are excluded due to lack of comparable data between the sites. The analysis of the historical trajectories is based on a narrative literature review of various written sources, e.g. journal articles, books and old newspapers, and thus the variety of the sources may include some author bias. Finally, the lack of interview data from the Breiðafjörður NR creates an asymmetry in the governance analysis dataset.

The MGM2 methodology used to calculate the economic impacts involves some innate limitations. The methodology is similar to the Travel Cost Method (TCM) and extends it with macroeconomic data. Thus, the general limitations of the TCM also apply, e.g. capturing only part of the non-market values (i.e. visitor experiences that have some associated costs), assuming that travel costs reflect visitors' valuation of their experiences (i.e. giving low or no value to experiences that visitors do not need to spend money on) and requiring special considerations and application of assumptions for multi-destination situations (Randall, 1994; Stynes, 2005). In reference to the total economic value of all 23 ES, the MGM2 methodology quantifies part of the economic values in the recreation and tourism category (Brander et al., 2024).

The MGM2 methodology also depends heavily on robust data and biases in visitor counts and spending data can have a major impact on the results (Flyr et al., 2025; Stynes et al., 2000). For visitor numbers, the study used official data from automated counters that are calibrated regularly, which is in general the optimal strategy (Kajala et al., 2007; Spenceley et al., 2021). However, automated counting may also contribute to sampling errors or biases due to location (usually primary entrances only), technical issues (e.g. lack connectivity or power), weather, and crowding, etc. (ibid). Visitor spending surveys were collected by convenience sampling at the main entry points, which may induce biases due to certain visitors being more or less likely to answer due to time constraints (e.g. visitors on a guided tour with only a short moment at the site are less likely to answer), language skills (surveys only offered in English and Icelandic), and the short window of collecting surveys at an individual site—often 2-3 days—may exclude some visitors due to seasonality or different holiday periods (Spenceley et al., 2021). These issues were addressed by attempting to reach every visitor arriving at the

site (random sampling), though this was not possible when big crowds arrived all at once, by helping visitors with language (guided filling) and by collecting larger than necessary samples to get more variation in the sample. To collect statistically robust visitor spending data in the future, a systematic strategy of collecting visitor data should be developed, informed by a preliminary study on the visitor types, seasons and segments.

Multi-destination spending was handled by a strategy developed from earlier publications as described in Chapter 3.2, but this comes with its own assumptions and simplifications that have an impact on the results. For example, in this study the total spending was simply divided by the number of PA sites visited during the day (and non-PA sites were excluded); a more informed calculation could be done if the visitor was asked how much time they spent at each site as is commonly done in TCM surveys. Regarding the regionalisation of the Icelandic I-O tables, the Icelandic Labour Survey only had 12 aggregated economic sectors, so the national I-O table with finer classification needed to be aggregated to match the Labour Survey, thus creating potential aggregation bias (Miller & Blair, 2022, pp. 161-162). Additionally, as indicated earlier, due to lack of separation of salaries from the value-added in the national I-O table, the results in the study exclude induced effects, reported in most similar international studies, reducing comparability.

It is also worth noting that an economic impact study such as the one employed here, by design, only reports the positive economic effects generated by visitor spending and does not account for any negative effects or costs to environment or society, such as soil degradation and erosion, waste and pollution, disturbance to wildlife, negative impacts of increased infrastructure, invasive species, loss of access to land or lack of affordable housing (Dehmel et al., 2026; Hjálmarsdóttir & Óskarsson, 2025; Ma et al., 2020; Sardar & Islam, 2025; Wolf et al., 2019). As a result, economic analyses should be used as a part of comprehensive sustainability or impact assessments (European Environmental Agency, 2024; Lee & Abdullah, 2024; Pegler et al., 2025).

The main limitations in concession study are related to the sample of interviewees. Invitations were sent to all NP managers and businesses regulated by concessions at the time. Most invited PA managers responded (75%) but only 30% of the invited companies. The interviewees cover all study sites for both PA administration and businesses, but the business representation consists of only SMEs as the large tourism companies either did not respond to the invitation or chose not to participate, causing a respondent bias in the study. Additionally, the scope of the stakeholder participation was intentionally limited to those directly involved with concessions; a wider study on stakeholder perceptions could also be conducted to cover all perspectives towards a comprehensive concession policy (e.g. NGOs, locals, municipalities, visitors, central administration, etc.). However, 21 in-depth interviews still provided a rich source of data for analysis.

Other limitations in the concession study included focusing on the south part of the Vatnajökull NP instead of the whole PA. Though the concessions are primarily employed in this area, it would have been interesting to hear stakeholders' comments from the other parts in order to inform future planning and management recommendations. While the study was ongoing, the state made further agreements with NGOs and private land-owners for operating services connected to PAs, and thus a more thorough analysis would soon be necessary to cover a wider variety of cases. Methodological limitations include qualitative coding done by a single researcher, inducing potential researcher interpretation bias. Though the study draws several conclusions that can be applied internationally, some of the stakeholder perceptions regarding the constraints and opportunities of concessions are rooted in the complicated legal framework of the Icelandic case study and might not be transferrable as such to other contexts.

The analysis of the PA management effectiveness and sustainability is, to the author's knowledge, the first case study on the use of the IUCN Green List in the Arctic. However, this may come with limitations on its transferability. For example, as Iceland does not have an Indigenous population, the results cannot be directly applied to many other Arctic contexts. The Green List self-assessment experiment and associated in-depth interviews were completed by five PA managers, which is a small sample, though comprehensive in the sense that these managers fill the annual national management effectiveness surveys, allowing the study to elicit comparisons to the national framework. The sample represents management authorities in all the NPs, but the study could have a benefitted from a wider range of governance contexts. Both the qualitative coding of the interview data as well as the mapping of the SDG and Green List indicators are subject to potential researcher bias; the mappings were verified by all authors of the individual study, but the interview data was coded by a single author.

Furthermore, the Green List self-assessment tool was a pre-release version, as the study was organised prior to the official release of the tool in collaboration with the IUCN. Thus, the experiences of the PA managers regarding the tool may not reflect the final published version. Feedback regarding the tool usability was shared with the IUCN for the development of the final release version as this was a supporting objective in the study.

4.5 Further research

This dissertation raises various topics for further research. First, conclusions from the governance analysis call for further research on adaptive capacity, co-management and resilience (Cumming et al., 2015; Islam et al., 2018; Schultz et al., 2015). These studies highlight how PAs are embedded in complicated social-ecological systems at different scales, and their effectiveness and adaptive capacity are connected to these systems. This supports the idea of larger, multi-objective and multi-category PAs that are

embedded in the socio-economic structures of the area and poses a major challenge to traditional top-down PA governance and management (Cumming et al., 2015). The study also identified a lack of clear national policies. As the variety of the governance models increases, will it be more challenging to provide consistent policy guidance? It would be interesting to study how locally or co-managed PAs can contribute to national PA policy that is still in most cases within the auspices of central administration.

Another policy research topic would be to analyse further how the results from the economic impact studies have been used in policymaking globally. Countries that systematically publish results of repeated economic impact studies have not clearly specified what are the intended outcomes of the studies besides rallying for support and being able to make comparisons with PA management costs, which may suggest this data could be underutilised (Finnish Forest Research Institute, 2009; Flyr et al., 2025; Metsähallitus, n.d.). Similarly, the visitor spending surveys provide detailed information about the visitors and while this data is of limited use in the economic impact analysis itself, it could be interesting to look at the visitor characteristics, behaviour and potential for development of better visitor management, new business opportunities and more sustainable tourism in the PAs, as called for in literature (Gundersen et al., 2015; Masný et al., 2018; Puustinen et al., 2009; Siikamäki et al., 2015; Smallwood et al., 2012).

Issues relating to methodological limitations and lack of detailed data in the economic impact study were discussed in the preceding chapter. Each of those issues encourage further studies with more extensive data or complementing studies that better catch non-market values such as contingent valuation studies or discreet choice experiments (Cerda et al., 2013; Hoyos, 2010; Mayer & Job, 2014). Economic impact analyses could also be adapted to catch concession-related spending, as the standard visitor spending survey cannot—without additional questions—discern the role or impact of concessions towards the outcomes and PA finances; an important part of financial sustainability for many PAs (Smith et al., 2021).

Further concession studies would benefit from a complete stakeholder analysis and coverage, focusing on the viewpoints of large tourism operators and their perspectives towards PA regulation due to their large role in mass tourism, and a wider range of case studies beyond the NPs. The study also called for framing concession agreements within a wider sustainability framework, and it would be interesting to see if it was possible to propose a general list of sustainability criteria for concessions that could be adapted to PAs in different contexts, e.g. building on Lackey and Bricker (2022).

Rapid environmental changes are increasing in PAs due to climate change (Dudley et al., 2025; Ford et al., 2021; Mori et al., 2024), and further research into concessions in such conditions or within an adaptive management regime could be very useful for PA practitioners. For example, concessions granted in particularly dynamic environments such as ever-changing ice caves, where the conditions of the concession

environment can change almost daily according to the PA manager interviews, may require new models for management and valuation of the concession.

In terms of a wider sustainability analysis, further studies could investigate PAs as part of the opportunity costs and externalities of nature-based tourism. Tourism comes with negative externalities for the society and it can be argued that PAs provide tools for locally sustainable management; however, the benefits for the local populations are met inconsistently (Blanco-Cerradelo et al., 2022; Nepal, 1997; Pfueller et al., 2011; Xu et al., 2009). Combining results of the governance and sustainability analyses could provide interesting perspectives into these challenges, similarly as the linkages between governance systems or socio-economic impacts have been analysed in relation to conservation outcomes (Ayambire et al., 2025; Dawson et al., 2021; Oldekop et al., 2016). Additionally, more research is needed in understanding sustainability in PA management from Indigenous perspectives.

The Green List study pointed out a general lack of studies on Arctic ES and better guidance is needed on how to evaluate ES in a PA context. Initial studies of general Arctic ES could provide a starting point for the PAs (Malinauskaite et al., 2019; Malinauskaite et al., 2025). It would also be interesting to evaluate management effectiveness assessment tools from a variety of governance contexts, e.g. locally- or privately-managed PAs, as the existing tools often reflect the perspective of a government authority.

The overall findings from the dissertation highlight the importance of further research in the intersection of inclusive PA governance models, socio-economic impacts and conservation outcomes in multi-use landscapes following ambitious KM-GBF targets (Adams et al., 2023; Cumming et al., 2025; Tjaden-McClement et al., 2025; Zafra-Calvo et al., 2019; Zhang et al., 2023). Indigenous PAs and privately protected areas (PPA) will have an important role, but many important questions regarding their operationalisation globally remain (Fitzsimons & Mitchell, 2024). Increasing requirements and recommendations for high-quality data on reporting ES and conservation outcomes as well as their cost-effectiveness also call for new kinds of partnerships between PA managers, researchers and local stakeholders; these could take form in joint research projects, planning and monitoring activities, supported by citizen science and new technologies (Dalton et al., 2024; Geldmann, 2023). Further studies on ES could also help in evaluating PA socio-economic impacts and environmental benefits within a single framework (Štrbac et al., 2022).

In the Icelandic context, it needs to be further studied what the different stakeholders value in nature conservation, what kinds of governance setups they find equitable and effective for nature conservation, and what would motivate them to engage with existing PA management authorities or even manage PAs and OECMs on their own; following the research priorities identified earlier (Fitzsimons & Mitchell, 2024; Ward et al., 2018).

5 Conclusions

This dissertation has provided a broad assessment of PA governance, economic impacts, sustainability and their management implications, contributing to the KM-GBF Target 3 through a better understanding of effectively and equitably managed PAs. The results also support establishing new PAs by augmenting governance analysis on the legitimacy-increasing factors. The dissertation synthesises findings from four independent papers employing the Icelandic NPs and PAs as case studies, providing a unique governance context as well as an increasing socio-economic focus due to the growing importance of nature-based tourism and its management in Iceland.

The dissertation shows that adaptive PA management does not rely on a single governance model as both co- and centrally-managed PAs were able to respond to pressing challenges. Governance diversity can be a strength for the PA system as it has been for Iceland, enabling it to provide locally-tailored and legitimate solutions. However, the diversity can become a challenge for policy coordination and capacity, as the different managing entities must address challenges each on their own. The adapted EGS framework provided a useful tool for analysing PA governance, identifying potential issues and providing suggestions for improvements. The dissertation highlights the importance of the understanding and developing the socio-economic context in PAs. The results of the economic impact analysis of tourism in the NPs showed significant contributions to local jobs and incomes as well as tax revenues; however, equity aspects were found to be more important. For example, the stakeholders' perspectives regarding concessions focused on the social impacts before the economic values. This strongly echoed findings from international studies and established concession systems, suggesting it is not a teething problem of an emerging concession system, but a part of the core equity challenge.

The findings highlighted the need to analyse PA management in a holistic manner through a sustainability lens, prompting an integrative experiment to analyse the Icelandic NPs using a prototype self-assessment tool of the IUCN Green List, a management effectiveness and sustainability standard for PAs. The dissertation analysed the Green List criteria through the ESG-pillars and SDGs, and concluded it provides a balanced representation of sustainability pillars for PAs, though it could be more ambitious in assessing equitable socio-economic impacts and climate change mitigation. There are more governance and socio-economic (or human) than environmental factors in the Green List, highlighting the importance of research, new innovations and applications in these areas for future PA management. The case study also identified a need for more ecological and ES data regarding the conservation outcomes.

The findings from this dissertation provide policy recommendations on various levels and together contribute towards the fulfilment of KM-GBF Target 3 globally and nationally.

General policy recommendations:

1) PA authorities should design new governance models for PAs together with the local stakeholders to increase legitimacy, local support and allow expansion of the PA estate. Different models have similar potential for adaptive capacity as long as the key stakeholders are empowered with the necessary legal and regulatory instruments. Governance analysis can support this process. Research indicates that variations of shared and local governance also contribute to better conservation and socio-economic outcomes.
2) It needs to be further studied what different stakeholders value in nature conservation, how they interpret equitable and effective governance, and what would motivate them to engage in PA management; in preparation for 1).
3) Concessions are viable economic instruments to regulate tourism in the PAs, but their implementation struggles to produce a sustainable approach in many places. Findings from this dissertation suggest building the criteria initially from a social equity perspective with a collaborative approach. Studies in the emerging literature can support implementation of a sustainable concession system but more research is needed.
4) Management effectiveness assessments remain the main tool for ensuring PAs are delivering conservation outcomes and governed equitably. Persistent data gaps call for more emphasis on cost-effectiveness of data collection, better control of management intervention impacts and ES assessments in addition to biodiversity monitoring. Both research and more focused efforts are needed, however supported by increasing public and remote-sensing data.
5) Sustainability is emerging as a new perspective in PA management as a response to increasing demands for reconciling environmental and socio-economic goals in PAs. Some management effectiveness assessments such as the IUCN Green List have included sustainability in the design, while some PAs have created their own localised assessments with local stakeholders. Though approaches vary, PAs should consider how to incorporate and assess sustainability in their operations as it not only addresses global sustainability challenges but also contributes to better governance and management by looking beyond the standard PAME process.

Specific recommendations for Iceland:

1) The dissertation suggests a need for stronger national coordination over the PAs, and the recently completed merger supports this. Future work on policy coherence should consider how to support increasing shared, local and privately-managed PAs as equal partners in national conservation efforts

towards the 30% by 2030 target and the planned introduction of OECMs. This could begin with research on identifying the local nature conservation values and motivations for engagement.

2) Economic impacts from the Icelandic PAs are significant. However, the legal and regulatory framework is still ambiguous and, in some instances, conflicting with the PA goals; thus, clearer national policy guidance is needed. Positive outcomes from the PAs depend on cooperation with people living around them, and national laws and regulations should work to support this.
3) Icelandic PAs need to increase their capacity on reporting conservation outcomes and ecosystem services, assessing physical stocks and socio-economic flows on the supply-side and determining beneficiaries on the demand-side. Recent initiatives have started to produce the ecological data, but it is still scattered in various organisations. Systemic models of reporting should be developed and connected to the management plans. Assessments of socio-economic impacts could be connected to ES reporting.
4) Iceland is doing well on coverage of management effectiveness evaluations thanks to systematic METT-derived analyses of tourism sites since 2017 and the MEPCA-assessment of the complete PA system in 2026. However, both methods are rapid assessments completed by PA staff only, and thus it is suggested to consider additional in-depth analyses on longer intervals with stakeholders, particularly in PAs where the integration of multiple values and uses is important.

Recommendations for future studies:

1) Further studies are needed to enhance the effectiveness, equity and expansion of the PA and OECM estate and support adoption of differing PA governance models focused on co-management and Indigenous, local and private stakeholders. Successful integration of governance, socio-economic impacts and conservation outcomes is relevant globally, and signals a need for sustainability framing beyond management effectiveness.
2) There is a need to develop new robust and cost-effective models and partnerships for monitoring and reporting on conservation outcomes and ES contributions, as well as better connecting the ES data to PA management. In an Arctic context, there is still a particular need for primary ES research.

Together, these policy and research measures will require collaboration across government agencies, local communities, researchers and PA managers, and strengthen PA governance systems by building institutional, social and knowledge capacity to provide effective conservation, generate positive socio-economic impacts for people, and address emerging sustainability challenges.

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Original Publications

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Diversity in Protected Area Governance and Its Implications for Management: An Institutional Analysis of Selected Parks in Iceland

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Abstract: A protected area (PA) is essentially a governance system, a spatially defined area encompassing natural and/or cultural attributes, governed by a set of actors with different roles and institutional frameworks. There are many types of PA governance systems, guided by historical-, site-specific- and context-dependent factors. This study has the objective to advance understanding of PA governance systems, their diversity and the implications for management. We take the case of Iceland and five of its major PAs. We develop an analytical framework for the study of PA governance systems, investigating their evolutionary trajectories, conducting a comparative institutional analysis of their environmental governance systems (EGS), and assessing their management implications using nature-based tourism as a key variable. We find this framework effective and applicable beyond this study. We find great diversity in the five PA governance systems that has not come by chance but deliberately negotiated in their protracted establishment trajectories. At the individual park level, such PA diversity can be embraced as a sign of an adaptive approach to governance instead of a one-size-fits-all solution while at the national level, however, such fragmentation constitutes coordination challenges. Our analysis of the current portfolio of PA governance systems reveals they accommodate most of the needed management measures, but a problem remains concerning scattered and locked-in individual governance systems that do not support coordinated action and sharing of expertise and resources. This calls upon policy guidance with more formal coordination, such as a legal and national policy framework embracing PA governance diversity, but also securing more coordinated measures for day-to-day management.

Keywords: conservation; environmental governance systems (EGS); institutional fit; legitimacy; park service

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1. Introduction

A protected area (PA) is essentially a governance system. It is a spatially defined area encompassing natural and/or cultural attributes and services, governed by a set of actors with different roles and institutional frameworks [1,2]. PAs represent a major land cover for most nations and have expanded rapidly in recent decades, currently covering, globally, nearly 17% of terrestrial areas in over 250,000 designations [3]. PAs are organised according to a variety of spatial and natural attributes, determining conservation goals, protection categories, and a wide range of allowed human activities [4,5]. Given this scale and diversity, there are also major differences in the PA approach to governance and in the effectiveness of their governance systems [6–9].

Parallel to the relatively recent expansion, PA governance has also evolved significantly, both in management approaches and policy objectives [4,10,11]. Earlier PAs were mainly focused on nature conservation efforts but gradually social and economic aspects, such as keeping rural areas populated and supporting local livelihoods, have become more

and more important [9,12,13]. Recent studies have suggested that employing inclusive governance processes and generating positive social impacts outweigh the importance of ecological effectiveness for local generating support towards establishment of PAs [14].

In a global perspective, PAs are operationalised via four broad main governance types: government—governed by the central government; private—governed by private actors; indigenous—governed by indigenous people; or co-managed—shared governance among actors at different levels [15,16]. This broad governance categorisation is, however, very general and leaves out many variations and approaches. Within each governance type there is great variety in governance elements such as of actor roles and institutional factors, and thus there are generally no "one-size-fits-all" solutions or models. Moreover, there is a need to consider the different trajectories of establishment and their context-dependent- and site-specific conditions [11].

Governance systems are supposed to be able to counter undesirable outcomes and deliver desired outcomes [1,17]. PAs are widely regarded as policy vehicles for rural development where tourism is seen as the key economic driver [18–20], and positive or negative socioeconomic impacts of PAs depend largely on their governance and management practises [21]. During their operation, PAs are exposed to multiple internal and external challenges [22]. However, once established, tourism can be defined as the main PA managerial challenge, given the human attraction of the various natural and cultural qualities such areas encompass [23,24]. Therefore, PA governance systems are expected to provide structures of governance to secure the conservation of the natural and cultural attributes and services of the PAs and concurrently drive sustainable outcomes linked to tourism activities.

Developments and challenges in PA governance are getting more attention considering international policy goals and expectations of significant PA expansion [13]. The European Commission [25] and UN Convention for Biological Diversity (CBD) [26] are targeting 30% terrestrial and marine PA coverage by 2030, nearly doubling terrestrial PAs and tripling marine PAs in just 10 years, and making designated PA land cover second only to agriculture [27]. To allow new PAs to be established effectively and existing ones expanded to facilitate compliance with the new targets, better understanding is needed regarding the diversity of formulation and implementation of protected area governance systems in different contexts and how different governance systems are fit to address new management challenges.

Iceland provides an interesting case to analyse the diversity of PA governance systems and its implications for management. It has allocated approximately one-quarter of its land under protection, with several different governance structures that have been shaped by different contexts, negotiations and socioeconomic factors and resulted in multiple governance systems with different legal bases [11,28]. Due to the importance of nature-based tourism as a major economic sector in Iceland, much attention has recently been given to the protected area estate and its economic role (e.g., [29,30]). At the same time, a tourism boom from 2010 to 2019 and high visitor numbers have resulted in tourism pressure becoming by far the biggest management challenge for the Icelandic PAs [31].

This study will use the example of five case studies from Iceland's PAs to advance understanding of PAs as governance systems, how governance diversity manifests in different systems and what implications diversity has on their performance. We therefore explore the following research questions:

1. What are the evolutionary trajectories of the selected PAs and factors shaping their governance systems? What can we learn from these processes for future PAs?
2. What are the attributes of the different PA governance systems and how do they compare?
3. What are the management implications of the different governance systems, using nature-based tourism as a key analytical variable?
4. What are the policy implications of the findings?

2. Materials and Methods

2.1. Background: Protected Area Governance in Iceland

Iceland is a sparsely populated country in the North Atlantic with a land area of 103,000 km^2, two-thirds of the 374,830 population living in the capital region of Reykjavik and a population density of only 3.6 per km^2 [32,33]. A significant part of the country is covered by uninhabitable highlands; less than 1% of the land area is built up in urban/recreational settings and around 3% devoted to agriculture [34].

Iceland has gradually been building its PA estate and currently PAs cover over one-quarter of the country in 122 designations [35]. Despite comparatively high coverage, PAs are a relatively recent phenomenon in Iceland. Apart from Þingvellir National Park, whose establishment in 1930 was timed to celebrate a millennium of the Icelandic Parliament, most PAs have been established after revision of the Nature Protection Act in 1971. Some of the largest area additions, such as Vatnajökull National Park and its appendices, are from 2007 onwards [28].

The formal governance features of Icelandic PAs are generally defined according to two main pathways for their establishment. Firstly, the general Nature Conservation Act 60/2013 [36] provides the legal framework for different categories of PAs, mainly following the IUCN management categorisation [5], and secondly, site-specific legislation which allows for a wide range of negotiation and flexibility regarding the governance system, actors' structure and institutional frameworks [28].

There are some defining factors of land governance in Iceland that impact and influence PA governance systems and are important for understanding regarding this study.

Iceland has two levels of government: central and local. The local governments enjoy a high level of sovereignty and are responsible for spatial planning, giving them significant control over land-related decision making within their jurisdictions. PA establishment and governance therefore commonly becomes an issue in relation to decision-making power between those two levels of government. These power relations have resulted in the central government rarely imposing PA establishment without seeking consent from the respective local government [11].

The "right to roam" principle on uncultivated land (almannaréttur) is another important factor for understanding the Icelandic case and in particular tourism management challenges following a similar trait as in other Nordic countries [37]. This allows for people to travel freely on and across land regardless of property rights. However, this right does not clearly differentiate between domestic wanderers or large-scale tourism, causing significant challenges for visitor management, including the issues of access, crowding and collecting service fees in the popular PAs.

There has been considerable debate around land development decisions and nature conservation, much of it focused on energy utilisation, and this debate has affected the establishment of many PAs [38–40]. Since 2010, the growth of nature-based tourism in Iceland has been particularly rapid, from around 500,000 to over 2 million annual visitors in 2018–2019, and over a million people visiting the most popular national parks [30,41]. This needs to be understood relative to the small overall population, capacity of the national infrastructure in general and PA management in particular [42]. Following the tourism boom, the economic value of PAs from nature-based tourism and recreation has been increasingly recognised in Iceland [30], and before the COVID-19 pandemic, tourism had become by far the largest economic activity with respect to export incomes [43].

2.2. Analytical Framework and Methodology

2.2.1. Environmental Governance Systems (EGS)

The study of environmental governance systems is based on the rich scholarship on institutions and common property resources [1,2,44,45]. We understand institutions as the socially constructed rules, norms and conventions to coordinate our interactions and, in the case of environment and natural resources, to steer our use towards desired outcomes [17]. A governing system consists of multiple actors and institutions involved in governance of

a particular resource [2,45,46]. The term governance system can then be understood as a social system for certain environmental and natural resources features such as a PA, with a set of actors with different roles and powers, and the dual role of institutions for actor-actor coordination as their coordination with the resource. We develop an environmental governance system framework based and expanded from Vatn [2] (Figure 1). This framework embeds the key elements for our analysis and gives an overview of the phases and actors in PA management from establishment to operation and outcomes. This connects to our research questions, hence: RQ1 focuses on the trajectory phase; RQ2 on the governance system; RQ3 on the interactions and outcomes; and RQ4 provides policy recommendation on the operational part of the system.

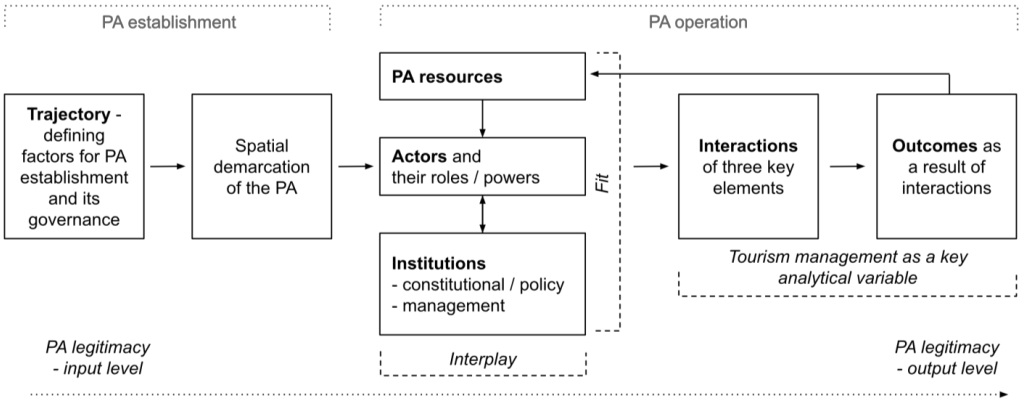


Figure 1. Environmental governance system (EGS) framework for the analysis of PAs (adapted and expanded from [2]).

We can identify the main variables of the framework we set out to analyse.

Firstly, EGSs are commonly an outcome of negotiations, power-contested tugs-of-war over multiple interests shaped by their development trajectory. Each PA has its own context and origins in terms of why, how and by whom it is protected.

Secondly, the area is usually spatially demarcated via legal enshrinement, defining the PA resources with certain natural and cultural attributes. These attributes, for example, size, ecological sensitivity, access, popularity and vulnerability to natural threats (e.g., climate change) or economic uses (e.g., resource-use within or around PA), directly affect both the policies and actions as well as protection outcomes.

Thirdly, the EGS itself has three key variables: the attributes of the PA resources, the actors with different roles and powers and the institutional structures for conservation and management of the area. Key actors in the framework can be understood as political, economic and civil society actors. Commonly, the institutional structures can be defined as either those operating on the constitutional or policy level, or on the management level of on-site rules, norms and conventions [2].

Government organisations and political actors at different levels shape the policies concerning PAs in interaction with the economic actors (e.g., resource users ranging from local farmers and tourism services to heavy industry) and civil society. Interactions of the policies, institutions and their implementation between the actors defines the outcomes of the EGS. Governance systems can be analysed and contextualised by studying the different variables of the system and how they interact.

2.2.2. Analysis of EGS Outcomes and Performance

The EGS performance is an outcome of multiple interactions between the individual variables in the framework. To examine and discuss the EGS performance, we employ

the concepts of legitimacy of the governance systems, and then their institutional fit and interplay.

The concept of legitimacy is useful for the understanding of EGS performance, and this notion is comprehended as involving not only legality but also how the systems incorporate and justify authority [47]. We differentiate between input and output legitimacy [2,48]:

- Input legitimacy concerning the appropriateness of the decision-making process, both from a legal process standpoint and its capacity to represent the interests of different actors in the governance system;
- Output legitimacy in terms of effectiveness (capacity to ensure goals are reached), efficiency (ability to reach goals cost-effectively) and the problem-solving quality of the laws and rules.

Input legitimacy is particularly interesting in the analysis of the trajectories of PA establishment. For this study, we take procedural legality as given, and focus on the participation and representation aspect wherein a significant shift has happened in recent decades concerning the establishment of PAs (e.g., [9]). Extensive stakeholder participation in PA design and management are also implied in the Aichi and upcoming CBD targets for PA expansion, which call for all PAs to be 'equitably managed' [6,26]. Concerning output legitimacy, our study focuses mainly on effectiveness and the EGS capacity for problem-solving and adaptation.

We employ the interrelated concepts of fit and interplay to examine the governance system's performance [17,49]. The concept of fit can be used to analyse how a governance system matches the spatial, temporal and functional attributes of the natural system. In Young's concept, spatial attributes are central to evaluating whether the governance system fits the natural system it is intended to manage [17]. Temporal fit represents how the governance system is able to adapt and respond to challenges in a timely manner. Functional fit represents the match between the ecosystem and institutional arrangements, e.g., features in the ecosystem that are not accounted for by the institutional arrangements signal poor functional fit [50]. There can be several solutions offering a good institutional fit for a given situation.

The concept of interplay describes how different institutions interact and impact other institutions [49]. Interplay takes place on horizontal (on the same level) and vertical (hierarchical) levels. As governance systems do not operate in an institutional vacuum, the different forces of interplay are important to understand how such governance systems perform like in our case of protected areas.

This study does not attempt to assess the conservation outcomes of the different PA governance systems. Such data on status and transition of the individual park natural resources in Iceland has not been available. However, new PA natural resources monitoring program on a national scale entered in force in 2021 and will in the coming years generate bio- and geophysical data, forming a basis for such study [51].

2.3. Methodology and Data

For the analysis of the trajectories leading to establishment of each selected Icelandic PA, we carried out an extensive narrative literature review (e.g., [52]) of these relatively well-documented processes in Iceland. To understand the origins and context of each PA, we aimed to answer the following questions from the identified literature: what the origin of the idea was, the timeline of the process, who/what was the driver for the establishment, who were the main stakeholders, what were the key issues in the negotiations and which were the key enabling factors that paved way for the PA.

We conducted an institutional analysis of the PA governance systems by analysing the respective legal and regulatory frameworks, employing the EGS model (Figure 1). Then we performed a content analysis of the PA management plans to evaluate what measures are proposed and offered for the management of nature-based tourism in the areas. Finally, we conducted an in-depth, semi-structured interview with a park director or head warden from each PA to get insight on how the governance structures and management plans

respond to actual needs in park management. The interviews were conducted remotely using Teams. They were recorded and subsequently transcribed; the question outline is provided in Appendix A. Topics related to the EGS analysis and policy implications were identified and are referenced as part of the analysis where applicable. Since Breiðafjörður Nature Reserve does not have a park administration or day-to-day management staff, no such interview was conducted in this case.

2.4. Sites Selected for the Study

This study focuses on the analysis of five significant and distinct PAs with varying governance structures, contextual settings and spatial scales: Vatnajökull NP, Þingvellir NP, Mývatn-Laxá Conservation Area, Snæfellsjökull NP and Breiðafjörður Nature Reserve (Figure 2; Table 1). In this analysis, we include all three national parks in Iceland and all PAs that operate under a site-specific legislation providing a comprehensive overview of the main governance systems for formally protected areas in Iceland.

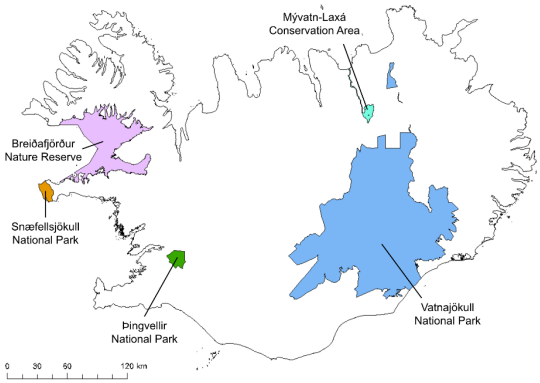


Figure 2. Map of Iceland with the PAs selected for this study.

Table 1. Description of selected PAs in the study.

	Þingvellir	Mývatn-Laxá	Breiðafjörður	Snæfellsjökull	Vatnajökull
Description	237 km^2 Close to the capital region in South-West Iceland. World Heritage Site. IUCN (II).	153 km^2 lake, river and 200 m wide lake shore and riverbank area in North-East Iceland. Ramsar site. No single IUCN category defined.	200 km^2 (excluding the sea beyond tidal coast) fjord between Snæfellsness and West Fjords. IUCN (V).	170 km^2 Tip of Snæfellsness peninsula in West Iceland. IUCN (II).	14,141 km^2 Covers a large part of south-eastern highlands, extensions in North Iceland. World Heritage Site. IUCN (II).
Key natural and cultural attributes	Historical parliament site, and rift valley between tectonic plates containing a lake system.	Protected wetland area around a lake and river system. Rich vegetation and birdlife. Surrounding volcanic and geothermal attractions.	Large shallow bay with over 3000 islands, islets and skerries and an exceptional combination of natural features, bird and plant life, and cultural and historical heritage.	Snæfellsjökull glacier and volcano. Unique volcanic landscapes by the sea. Cultural and historical heritage.	The shaping forces of fire and ice. Vatnajökull ice cap dominates the park in the central highlands; also contains large and varied regions to the north, west and south Iceland.
Relevance to study	First NP in Iceland. Special status under parliament. Single most visited PA location.	Most popular PA location in the north. Managed under site-specific legislation.	Site-specific legislation using a local management model. Limited number of visitors.	Only NP under the generic Nature Conservation Act.	Innovative co-management model. High visitation numbers.
Peak annual visitor numbers	1,526,523 [30]	409,091 [30]	Ferry 6-8/2019: 32,588; Flatey island: 11,982 [53]	392,168 [30]	735,728 [30] (at Skaftafell visitor centre)

3. Results and Discussion

3.1. Historical Contexts and Trajectories Shaping PA Establishment and Approach to Governance

Þingvellir NP has a unique history among the Icelandic PAs. The idea for the park was raised by the State Antiquarian in 1907, referring to international development in conservation and pioneering park establishment such as Yellowstone in the US, and identifying locations in Iceland he deemed of high conservation value [54]. Another article [55] triggered more public discussion about the park and 15 years later the Act 59/1928 for the protection of Þingvellir passed parliament [56]. The park was formally established in 1930 celebrating the establishment of the Icelandic Parliament in 930 CE in the heart of the park. There were no existing nature conservation laws as this was the first PA in Iceland, and since it centred around one of the nation's most valuable cultural-historic sites, the process was parliament-driven and had strong support from the public. This was based on the idea that the parliament site and surrounding rift valley would be conserved as a shrine for the future generations [56]. Þingvellir's legislation was not updated until it became an NP through Act 47/2004 [57].

Mývatn-Laxá Conservation Area has its origins in Iceland's first major conservation versus resource utilisation conflict [58]. The Laxá river flowing out of Lake Mývatn had already been dammed in the 1940s and 1950s for two power stations, and plans for a third one with a 57-metre-high dam were proposed in 1968 [59,60]. This plan would have submerged most of the river valley, triggering a fierce debate both locally and nationally about the lands of the farmers in the valley and of the future implications for nature in the area. Regardless, the plan got a green light from the local government who wanted to ensure sufficient power generation capacity for the growing population and industries in the city of Akureyri and the construction started. Local farmers started a conservation association for Mývatn and Laxá, and during the height of the debates in 1970, members of the association used dynamite to blow up one dam of the original power plants [61]. The plans to build the new dam were turned down by the national government, yet the construction continued, triggering several new lawsuits from the local landowners. Finally, the state stepped in to lead difficult negotiations between the landowners and the power company, and a settlement was reached in 1973; a small power plant not affecting the water levels was allowed to be finished and the state funded pathways for migratory fish to bypass the dams, paid the costs of the pending lawsuits and established the PA under site-specific legislation allowing existing uses in 1974 [59].

The idea of protecting Breiðafjörður was presented in parliament in 1978 and agreed as a parliamentary resolution in 1979, but this agenda only moved forwards in 1993 after local councillors presented the idea again with support of the Minister for Environment at the time [62,63]. The idea of creating a conservation area and having site-specific legislation was facilitated by the law on the protection of Mývatn-Laxá from 1974, and formulated in several meetings in the local municipalities [64,65]. Consensus for the protection was reached in December 1993 with a draft for the law. The law proposal was submitted to parliament in 1994 and passed as Act 54/1995 [66]. Establishment of the Breiðafjörður Nature Reserve was particularly strongly driven by local municipalities in comparison to many other PAs in Iceland; local control of the PA, spatial planning and traditional land and marine resource uses were central themes in the negotiations. Securing these rights ensured local support for the law, leading to a site-specific law and locally managed governance model [66].

There was a long trajectory following the establishment of Snæfellsjökull NP. The idea of a national park in the area, including the iconic glacier, was proposed by a Minister and the chairman of the Nature Conservation Council (Náttúruverndarráð) in the early 1970s [67]. The area was inspected by the Council in 1974, and a proposal was made by them in 1977 for a nature reserve under the glacier [67]. However, official parliamentary preparations began only in 1993 and a parliamentary proposal was submitted in 1994, with two committees working on the idea from 1994 until 2001 when the park opened [67–70]. Since the beginning, local champions from the municipalities surrounding

the park, the Federation of Municipalities in West-Iceland and local MPs were active participants in the negotiations and preparatory work with the Ministry for Environment, who led the process [67–70]. This process was generally low on conflict and characterised by mutual trust, so site-specific legislation or other special arrangements were not requested in the negotiations; the park was established under the conditions of the general Nature Conservation Act and is still the only such NP in the country.

Vatnajökull NP was formed as a merger and large, stepwise extension of Skaftafell and Jökulsárgljúfur NPs [11]. The idea for a larger park in the Vatnajökull glacier realm had been raised and debated for a long time, with many of the contentions relating to conflicting interests in energy utilisation versus conservation [71]. It had a strong drive from the municipalities particularly in South Iceland with hopes to provide opportunities for rural development, and the decision to establish the park was made partially in reconciliation for the construction of the Kárahnjúkar hydropower plant east of the park boundary [71–74]. Parliament initiated the inquiry for the park in 1999 and a recommendation for the park was made in 2004 by the Parliamentary Committee. A working committee was established to deliberate on the park boundaries and management model in 2005. It worked until the dedicated park-specific Act 60/2007 [75] was passed and the park officially opened in 2008 [76]. The act provided a major change from its predecessors, Skaftafell and Jökulsárgljúfur NPs, that had been governed with a top-down governance structure, and transitioned towards an innovative co-management approach to governance that was designed as part of the planning and negotiation process and seen as a precondition for the park establishment by the local government actors [11].

These evolutionary trajectories that led to the establishment of the five PAs illustrate different timeframes, processes, power relations, conflicting interests and factors that directed and shaped their distinctive governance systems and available management options. What we also find is that the diverse and often protracted trajectories that shaped the five parks' creations have been able to become inclusive of local actors' interests and in general, they are therefore enjoying a high level of input legitimacy.

3.2. The Different PA Governance Systems: A Comparative Institutional Analysis

3.2.1. Þingvellir National Park (ÞNP)

The site-specific legislation that formally outlines actor roles, mandates and institutional properties of the governance system for ÞNP was last updated through Act 47/2004 [57]. It came with multiple changes such as an expanded area, objectives sharpened, the term National Park manifested and new measures for more effective management [77]. There have been further amendments of the legislation important for its governance since, especially in 2019 with new clauses that allowed the park to regulate commercial activities within the itself [78]. Þingvellir NP is an independent government agency that reported for a long time directly to the Prime Minister's Office but since 2017 to the Minister for Environment (Figure 3). The park's decision-making power is vested in the hands of the legally mandated Þingvellir Committee formed by seven members of Parliament, elected every 4 years in the beginning of the parliamentary term. The Þingvellir Committee appoints a Park Director responsible for executive decisions and day-to-day management with the head warden and interpretive manager. The legislation does not include roles of any other actors in park management and thus, is an example of a fully centralised PA governance system. Funding is administered directly from the state budget via the Ministry for Environment.

ÞNP has been an exceptionally popular tourism location and prior to COVID-19 it received around 1.5 million annual visitors. The visitor presence generated by these numbers, more than doubling from 696,000 in 2015 [79], in a relatively small area has become the single most important management challenge, manifested in several issues to handle such as parking, sewage, crowding, trampling etc. [80,81]. High visitor numbers have allowed the park to generate significant income from tourism fees; mainly from service provision and parking that provided around 80% of its overall income in 2019 [82]. This

greatly aided the park during the tourism boom, but also created significant sustainability challenges as this revenue source diminished greatly during the COVID-19 pandemic.

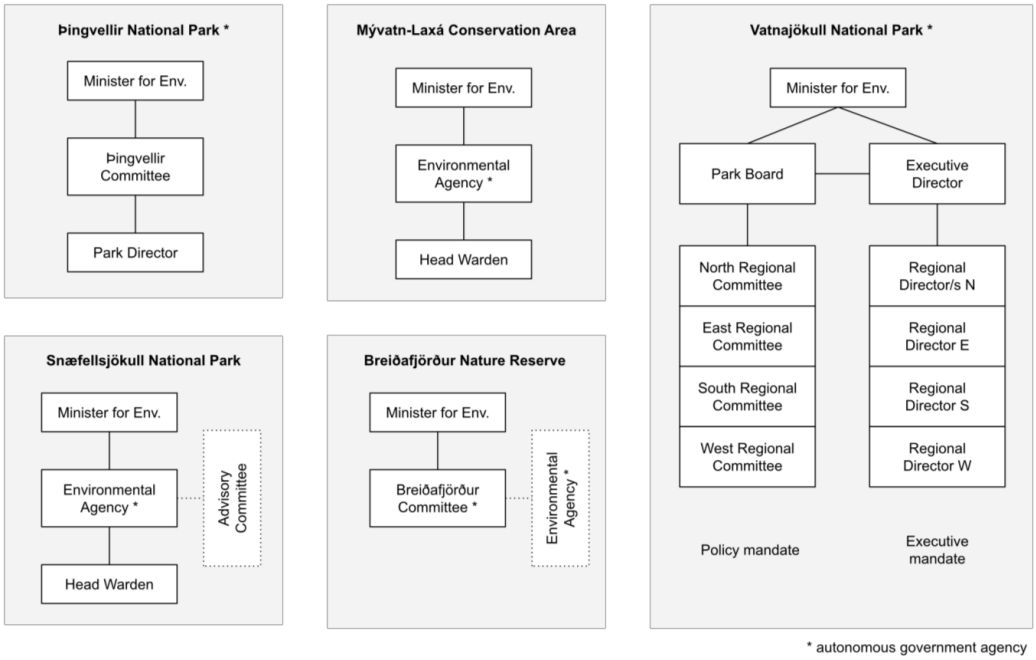


Figure 3. The governance system structures for the selected PAs (Vatnajökull NP [11]).

There is no legal requirement to create a management plan for ÞNP. However, the legislation requires the park to have a policy document, currently implemented as a vision and steering document [80], that functions as an updated management plan [83]. The policy goal ties closely with the idea of keeping Þingvellir as a shrine for Icelanders and the land as original as possible. This coincides with the top-down approach in the park governance system, and hence, does not require any direct involvement of other stakeholders in making the management plan. The current park administration has, however, responded to this by creating a broader consultation process in the making of the park vision that is inclusive of multiple stakeholders, and the park management also sees the importance of consultation through other non-PA specific public administration and good governance laws according to the interview data [83].

Our institutional analysis reveals that the ÞNP governance system has been adaptive and well fit to addressing upcoming management challenges, e.g., the boom in tourism. As the park's centralised governance system holds all executive and decision-making power and operates as an autonomous government agency with short command lines, it can respond to situations and needs quickly. According to a respondent [83], the park has been able to respond to the rapid increase of tourists by providing needed conservation infrastructure; it also pushed for the update of the legal framework to allow for more effective tourism management and enacted clauses that allowed the charging of the parking fees which now form a majority of its budget and help in paying for improved infrastructure and ranger services. These examples convey how the park can be managed effectively when it has a high profile and centralised management.

As made clear by our respondents, the ÞNP legal status and autonomy impacts greatly forces of institutional interplay. The park administration is powerful when interacting with other structures of governance, both within the central and local governments such as on issues of road construction and municipal spatial planning, to name but two [57]. ÞNP

does maintain an active dialogue with the tourism industry and research institutions [83], but these are not legal obligations and these consultations operate more informally.

3.2.2. Mývatn-Laxá Conservation Area (MLCA)

The MLCA was established under site-specific legislation that sets the elements of its governance system, with the Environmental Agency (Umhverfisstofnun, abbr. EA) as the sole responsible government agency for managing the area (Figure 3). The legislation allows for the establishment of bylaws where rules concerning use and access restrictions can be established. The EA can also delegate management responsibilities to other parties according to the law on a contractual basis. Additionally, the law defines the scope of the Mývatn Research Station to conduct research and monitoring in the area as a government agency, however without a direct role in management of the park. The costs of running MLCA are covered from the state budget and funds are administered by the EA.

There is a legal mandate to create a management plan for MLCA, and there are requirements for a wide stakeholder consultation in its making, including the local governments, regional environmental NGOs and government agencies [84]. This creates an effective venue for more stakeholder inclusion, although the EA retains the lead executive power in the park's governance system. The current management plan provides a detailed list of specific activities and improvements, for example, indicating which areas should be accessible by footpaths and information and how certain areas should be protected, but otherwise lacks measures to manage visitor pressure [85]. Neither the legislation or management plan mention regulating commercial tourism activity–for example, permits can be issued only for resource-use purposes in the area–indicating how the governance system is still somewhat tied to its origins in the hydropower versus conservation conflict, and slow to incorporate challenges posed by commercial tourism.

However, the park bylaw was updated in 2012 [86] with more measures to limit traffic and visitor activity in the park. The bylaw also stipulates that further rules on traffic and tourist access can be set in the management plan. Additionally, as the MLCA makes use of the Nature Conservation Act (NCA) [36] when applicable on issues not set in its site-specific legislation. The NCA indirectly provides the park with measures for commercial tourism management, though this option has not yet been used. With the NCA and the new bylaw, the park management currently has the necessary measures to regulate tourism effectively in the area according to a respondent [87].

These updates suggest that the institutional fit of the MLCA governance system has improved significantly even though it remains somewhat complicated, drawing on indirect elements. The fact that the current management plan from 2011–2016 is long expired remains a sign of misfit. If a PA can be managed without the main planning tool for 5 years during the height of the tourism boom (and subsequent lull of the COVID-19 pandemic), it suggests the management plan has not been an effective tool. This became evident in an interview, where it was noted that the existing management plan had not been sufficiently practical, and the stakeholder engagement for the new management plan had been complicated and stalled the renewal process [87]. These are important findings related to horizontal and vertical interplay of the governance system, and in general, participatory PA management. Inclusive management and stakeholder participation are important for legitimacy in PA governance, but how it is being conducted matters. If the roles and responsibilities are not clearly set and agreed, there is a lack of trust or the ownership is unclear, the outcome can be compromised and lead the governance system to experience gaps in institutional fit and dysfunctional interplay.

3.2.3. Breiðafjörður Nature Reserve (BNR)

The site-specific legislation of BNR employs a local management approach to governance [66]. Its governance system puts mandate and powers in the hands of an independent management committee as the lead actor, the Breiðafjörður committee, reporting directly to the Minister for Environment (Figure 3). The municipalities must consult the Breiðafjörður

Committee regarding spatial planning in the area. The Committee has seven members: four from local municipalities, one jointly from the Icelandic Institute of Natural History and the Nature Centre of West Iceland and West Fjords, one from the National Heritage Council and the chairperson appointed by the Minister. The EA has an advisory role to the Committee and may decide on some construction permits and resource-use licenses. There are limited provisions for park management in the legislation, but further bylaws are allowed. None have been set so far to regulate visitor activity or commercial tourism; however, the visitor numbers in the BNR are relatively low compared to the other case studies albeit not well-recorded. Funding for BNR is provided directly from the state budget, administered by the committee. The BNR funding is low, almost only to meet the cost of the committee members and their meetings.

There is a legal mandate to create a management plan for BNR, generated by the Breiðafjörður Committee in consultation with local municipalities, subject to approval by the Minister. The current management plan 2014–2019 [88] contains plans for protection of landscapes, geological formations, ecosystem and cultural heritage. It also aims to prepare the area for a growing number of tourists, increased research, and traditional utilisation of land and marine resources in the area. Economic activities (e.g., tourism, energy production, fishing, farming) and development projects are allowed as long as they do not contradict conservation values. Normally building permits are issued by the local municipalities, but projects outside of approved municipal spatial plans need to be approved by the EA. BNR's management plan contains several informative or educational actions to support tourism in the area but mentions no measures to manage tourism pressure though such protections are within the scope of the plan in the legislation. The Act on Breiðafjörður allows the Minister to issue regulations to restrict tourist access to vulnerable natural monuments in the PA on the Committees proposal, but this could be a slow way to respond to sudden pressures given the lack of other restriction measures in the management plan.

The Committee has executive power over the PA and is responsible for implementation of the management plan it creates, but it is not specified in the legislation who should do the day-to-day work. The Committee has only one part-time (25%) employee taking care of administrative duties. The management plan envisages that Breiðafjörður should have a full-time ranger, but it took until 2019, almost 25 years after establishment, for the PA to get a part-time ranger service [53].

BNR does not have status as an autonomous government agency. Several spatial and temporal issues lead to question marks about whether the current governance setup is indeed fit to manage such a large area. The institutional fit of a governance system suffers if it is not defined or clear how to execute day-to-day management. Issues of vertical and horizontal interplay could also play a part here; the BNR seems disconnected from the other actors in the Icelandic PA governance system, lacking legally-enshrined cooperation structures e.g., with the EA.

Many of the issues related to weak executive capacity noted here have been recognised by the Breiðafjörður Committee. It opened a public dialog regarding the future of Breiðafjörður in 2019 and produced a report charting options for designations and changes in its operation [89]. The report acknowledges limited progress so far due to limited resources and lists six key points that need to be tackled when the legislation is updated, including establishment of permanent management staff and implementing stronger regulations regarding protection measures. Updating the management plan has been put on hold until the decisions regarding the future legislation are made.

3.2.4. Snæfellsjökull National Park (SNP)

The governance system of SNP is based on the NCA that otherwise defines most of Iceland's PAs, except those with site-specific legislation [36]. The Environmental Agency is the lead actor responsible for management of PAs, except for county parks that are run by local governments (Figure 3). Moreover, the EA can delegate its PA managerial role to other actors on a contractual basis apart from national parks. The NCA does not

allow for direct sharing of powers in PA management, but for national parks it provides a legal basis for consultation committees for the head warden. The membership of those committees is limited to local governments, government authorities and NGOs in the fields of environment and tourism with a consultation role. The governance system for SNP is therefore highly centralised with the EA as a lead actor. It has also, with backing in the NCA and detailed in a bylaw [90], established a consultation committee that is active and meets on a regular basis, seeing the local government and other government agencies serving as members. Funding for SNP, as other PAs under the NCA (except for county parks), comes from the state budget via the EA.

The NCA demands all PAs to have management plans and sets out directions for the process of their development, contents and public participation. The SNP management plan has been formed by the EA in consultation with the Icelandic Institute for Natural History, municipality of Snæfellsbær and tourism operators [91]. The institutional arrangements in the current plan focus on infrastructure development and allow for the closure of areas to protect nature from tourism pressures. The management plan also allows the park to charge visitor fees to deal with damages from tourism. Following allowance for business activity licensing in the NCA, the management plan also mentions use of licensing to manage business activity, and the park has licensed activities such as cave and glacier tours to local tourism businesses.

We find the park provides a good institutional fit. The EA has the capacity and necessary frameworks for the protection of such areas. The NCA specifies management measures both for managing tourism pressure in terms of area closures and economic development in licensing models. According to our interviewee [92], the park management is content with the measures provided by the NCA and is also planning several soft ways to distribute tourism traffic during peak hours; additionally, high-frequency visitor days such as cruise ship visits to nearby towns are co-planned with local tourism providers. The SNP EGS is well-connected both vertically—with active interplay in the advisory committee to the local municipalities and tourism operators—and horizontally by collaboration with other PA governing institutions in Iceland—for example, by being the main organiser for the annual ranger course as mentioned in an interview [92].

3.2.5. Vatnajökull National Park (VNP)

The park-specific Act 60/2007 [75] of VNP defines a tailor-made co-management governance system, based on power sharing devolved to the local level (Figure 3). The park is an autonomous government agency that reports directly to the Minister, but the Minister's privileges are limited to chair and vice-chair nominations on the Park Board, approving the management plan and intervening only if measures in the plan are against laws. Its main decision-making authority is the Park Board with seven members: chairpersons of the four Regional Committees, one representative of environmental organisations, and the chair and vice-chair. The Park Board is responsible for park policy, budget, regulations, supervision, employment policy and coordination including the park's management plan. A Park Director is appointed by the Minister to hold executive decision-making power parallel to the board. Regional Committees operate each of four regions as independent business units, making decisions regarding local operations and preparing the regional management plans. Regional Committees have six members: three representatives from local municipalities, one from local tourism associations, one from outdoor recreation associations and one from environmental associations. Regional Managers are responsible for day-to-day operations in the regions (see [11]). The management plan for VNP is prepared by the Regional Committees and merged to a park-wide document by the Park Board. Funding for VNP is administered from the state treasury by the Ministry for Environment and the park also collects service fees set in a bylaw [93].

Institutional fit of VNP has benefited from its co-governance structure. Being a vast park with different regions in terms of natural attributes, populations, services and priorities, placing planning and decision making in the Regional Committees has provided

necessary flexibility and allowed regional identities to emerge [11]. The park has been able to respond relatively effectively to the tourism pressure by facilitating legal and regulatory amendments allowing the park to regulate commercial tourism by requiring permits and licenses for commercial activities within the park [94]. The co-management structure has also effectively become a venue for vertical interplay between the local and central administrations [11]. The management plan is the central planning document for the park and the local government spatial plans need to be aligned to it; it consolidates the decisions to the higher administrative levels [95,96]. However, it was noted in the interview that the consolidation process was found to be very heavy and it was suggested that the park might dissect the whole park plan to regional management plans as a potentially speedier and more locally relevant solution [97].

In terms of horizontal interplay, the status of an autonomous park authority has provided the park with a raised platform nationally to highlight its issues and progress, and allowed it to lobby effectively for funds for park development following the ambitious objectives in its legal framework [11]. In comparison to parks under the NCA and EA, this is a special privilege. Another issue regarding horizontal interplay was raised in the interview: the park would like to regulate traffic on some roads within the park but under current legislation, this is not possible without taking full responsibility of the road management from the Road Authority [97]. Regarding vertical interplay, VNP has been efficient in coordinating the interaction between different decision-making levels due to its co-management structure [11].

Table 2 provides a synthesis and comparison of the key documents and management measures for the governance systems analysed in this chapter.

Table 2. Comparison of the governance setup for selected protected areas.

	Þingvellir	**Mývatn-Laxá**	**Breiðafjörður**	**Snæfellsjökull**	**Vatnajökull**
Current governing laws and bylaws	Act 47/2004 on Þingvellir NP [57], updated by Act 85/2019 [78], Bylaw 848/2005 [98]	Act 97/2004 on Protection of Mývatn and Laxá [84], Bylaw 665/2012 [86]	Act 54/1995 on Protection of Breiðafjörður [66]	Nature Conservation Act 60/2013 [36], Bylaw 935/2021 [90]	Act 60/2007 on Vatnajökull NP [75], updated by Act 101/2016 [94], Bylaw 300/2020 [99]
Management type	Centralised	Centralised	Locally managed by the Breiðafjörður Committee.	Centralised with local gov. involvement in advisory role.	Co-managed between national and regional gov. and civil society.
Responsible organisations	Parliament appoints 7 MPs to Þingvellir Committee, ÞNP park authority.	EA.	The Breiðafjörður Committee has 7 members appointed by the Minister.	EA with an advisory committee.	National Park Board with 7 members, Regional Committees, VNP park authority.
Day-to-day operations	Park Director, ÞNP park rangers.	Head Warden, park rangers by EA.	Committee supervises, no park management.	Head Warden, park rangers by EA.	Park Director/ Reg. managers, VNP park rangers.
Current management plan	2004–2024 [100], update 2018–2038 [80]	2011–2016 [85]	2014–2019 [88]	2010–2020 [101]	2011–2021 [95], update 2013 [96]
Management plan formation and approval	Prepared by the park, approved by Þingvellir Committee.	EA in consultation with local authorities and NGOs in the area, approved by Minister.	Breiðafjörður Committee in consultation with the local municipalities, approved by Minister.	EA in consultation with Icelandic Inst. of Nat. History, local gov. and tourism operators. Approved by Minister.	Regional Committees prepare regional plans, Board reviews and merges to overall plan, Minister approves.
Measures for managing tourism pressure	Restricted motor traffic. Visitors only on managed footpaths. Can issue penalties.	Restrictions in traffic and visitor access allowed in bylaws. Can issue penalties.	Law allows for a bylaw to define management measures, but this has not yet been issued.	Restrictions in traffic and visitor access allowed in bylaws. Can issue penalties.	Damaged or threatened areas may be temporarily closed by VNP. Can issue penalties.
Measures for commercial activity management	All business activities are subject to license. The park recognizes its role in supporting economic activities.	EA can issue permits for resource-use. Commercial tourism subject to permit indirectly via NCA.	Development projects in general are allowed if they do not risk conservation values.	All business activities are subject to license. Visitor fees can be collected 'to limit or repair damage caused by tourists.'	All business activities are subject to license. VNP may charge visitor fees for services and access to the area.

3.3. The PA Governance Diversity and Its Multiple Implications

When comparing the five PA governance systems and the trajectories of their establishment guided by the analytical framework, some important themes emerge.

The trajectories leading to the establishment of the five parks are all different; however, all involve long processes lasting many years where discussions of their important natural and cultural attributes revolve in public debate prior to a formal decision to establish the PAs. There can also be direct political drivers and motivations, seeing the park establishment as a reconciliation in conflicts around resource use, either as a trade-off relating to development versus conservation (VNP) or the PA as a measure to curb suggested development (MLCA).

These trajectories impact greatly what type of an EGS the respective PA gets. As we examine the links between the trajectories and EGS (see Figure 1) for the five parks, the following connections become apparent: The nationalistic and historical legacy factors contributed to ÞNP being granted status as an autonomous government agency, directed only by members of parliament in a top-down EGS management fashion, keeping the intergenerational connection between the old and contemporary Alþingi with a site-specific law. The conflicting trade-offs in the prelude to VNP between contested conservation versus energy utilisation resulted in a co-management EGS that was simply a precondition for the big park established at all and agreed upon by the local actors. Due to the grand scale of the park and need for detailed divisions of roles and mandates between park actors—its interplay with other land-use institutional arrangements—site-specific legislation was needed, which also granted VNP status as an autonomous government agency. The local initiative to establish BNR involving a careful transfer of power from landowners and local governments resulted in an EGS with a site-specific legislation and community-led park administration that has had limited institutional attributes capable of interfering with business-as-usual practice in the area. The lack of counterparts from actors on other levels in the community-only EGS seem to have resulted in a lack of facilitation of updates and progress. At Mývatn-Laxá, the political outcome to stop hydropower dam-building was incorporated within site-specific legislation halting such development as a primary objective but not allowing co-management. Finally, SNP was co-created by the central government and local actors over a long trajectory, characterised by low conflict and high level of trust, being the only NP in Iceland based on the general clauses in the NCA without any tailor-made solutions in its EGS. Interestingly, due to the high level of overall legitimacy at SNP, informal collaboration has taken place among park-related actors with planning and decision-making shared far beyond legal provisions. This comes as a deliberate attempt of co-management to share powers and increase legitimacy in the park management, although restricted by the general legislation.

The EGSs for the different parks—as different as they are—are generally well fit to meet their stated objectives according to our analysis and more importantly, have proven to be adaptive to address emerging management challenges as they rise. It would be difficult to draw the conclusion that one EGS is superior to another; they all have their strengths and weaknesses. Some of these strengths/weaknesses are embedded in the governance systems, hence the duality that a particular EGS will typically have particular challenges. Looking at some of these dualities, we see that a co-managed EGS (VNP) suffers from lengthy and complex decision/command lines but amplifies legitimacy at the output level with its high level of actor inclusion and adaptability. The top-down model of EGS (ÞNP) is more lean-and-mean and allows for quick management responses but has lower output legitimacy due to lack of inclusion in its planning and decision making. Lastly, placing only community actors in the lead of PA EGS (BNR) suffers from being side-lined in competing for funding and risks not being heard. These observations add to the discussion on evolving park governance and the applicability of different governance types and systems [9,15].

There are no panaceas when designing EGS for protected areas; instead, there is a need for a nuanced understanding of their context-dependent nature and capacity to adapt. Rejecting panaceas is well documented in the institutional literature [45,102], but needs to

be constantly reiterated to counter the drive for blueprint, straight-jacketed governance solutions. This is an important lesson also from our study, and it might require site-specific legislation to accommodate all necessary interests. Looking beyond the individual park-management level, however, such EGS fragmentation and diversity can constitute multiple challenges at the national level. This can relate to the development of a coherent, effective national system of PAs [103], to economic actors and park users, and on the development and expectations during the creation of new PAs.

This calls therefore upon strong policy guidance with more robust structures than only informal park-to-park exchanges. In the case of Iceland, the measures for this might come as a merger of the agencies into a park service commonly found elsewhere, or a legislative and policy update that would allow and embrace PA governance diversity but secure more coordinated measures for their day-to-day management. The need for a stronger shared vision across the PAs and means of sharing knowledge and capacity was also brought up by an interviewee [92]. The current portfolio of PA governance systems accommodates most of the needed attributes and measures, but a key problem is its scattered form and locked-in individual governance systems that do not support coordinated action.

3.4. Wider Implications of the Findings

This study adds to and expands the growing literature on PA governance systems worldwide (e.g., [11,104–108]), and aids in the more detailed understanding of their diversity, beyond the classic 'centralized-, private-, indigenous- and co-managed management' typology [15]. The growing scholarship in institutional analysis has generated multiple frameworks to allow for analysis of governance systems, recalling our application of the EGS framework but also Ostrom's Institutional Analysis and Development (IAD) and various Social-Ecological Systems (SES) frameworks [2,45,109]. These are jointly advancing the study of how the large and growing PA estate can be governed towards sustainable outcomes. This is utterly important; more 'paper parks' is not the aim of the growing global aspiration for more park coverage, but parks that are well-governed, equitable, inclusive, and adaptive in their approach to management [15,110,111].

This study contributes to deeper understanding of PA governance, being novel to the Icelandic park estate and beyond, by providing an original adoption of the general EGS frameworks to the case of PAs that we find well suited for advancing a nuanced analysis of their governance systems. Our adoption moves beyond an understanding of a park EGS as static by placing the framework in an evolutionary context of the park establishment trajectory and the understanding of their adaptability to change. In an uncertain future, learning from the past truly applies for parks.

The multiple global environmental changes of our era are driving park expansion (e.g., [112,113]). Our novel analysis shows how intricately the institutional park setup is linked to the historical origins and establishment trajectories of each PA. Understanding the context and including the stakeholders in the negotiations was a key factor for legitimacy of the Icelandic PAs during their establishment, coinciding with other studies (e.g., [114–116]), and an important reminder for the future as countries expand their PA estates and strive towards new conservation targets [25,26,117]. For the future, we see further opportunities in advancing the study of PA governance systems and their dynamics, especially on the park governance systems' adaptive management capacity (e.g., [118–120]) and resilience (e.g., [121,122]).

4. Conclusions

Within Iceland's PA estate, we find a great diversity in governance systems, both in park actor structures and institutional arrangements. This has not come by chance, however. Our analysis of their establishment trajectories reveals how the different PAs were suggested and negotiated, and the key features of their governance systems deliberately outlined in formal legal frameworks. This partly results in these major parks in the country enjoying high input legitimacy, hence their establishment phase is generally perceived as legitimate.

For this study, we developed an environmental governance system (EGS) framework purposely for PA analysis, based on the well-established scholarships in institutional analysis and governance [2,44,45]. We find this framework useful and effective for conceptualization and analysis of defining factors of PA governance systems and applicable beyond this study.

Our analysis of the individual PA governance systems shows that their initial trajectories greatly shape their attributes and that there is an attempt to tailor solutions to the differences in the PA social context. This has surely been a vehicle to secure their legitimacy at the input level. Recalling Ostrom's [45] strong argument, there are no "panaceas" when creating governance systems for PAs at their initial stage as our analysis has disclosed. Such PA diversity can be embraced as a sign of an effective approach to governance instead of trying to fit all into singular, blueprint-based solutions.

This diverse approach to governance has however come with its challenges, in particular concerning their fitness to effectively manage and adapt to challenges that can put their conservation values and sustainability at stake. In the Icelandic case, the boom in tourist numbers—from a stable 500,000 annually in 2010 rising to 2.5 million in 2018—has been such an abrupt challenge for a nation with a population of less than 400,000. We found the PA governance systems in the study initially lacking effective legal measures for management, but multiple adaptations have been implemented since to address this. We find the co-managed governance system in Vatnajökull NP to be the most adaptive and pioneering in developing its institutional framework to more effectively cope with the rapidly growing tourism. This is facilitated by the co-management aspect; hence, adaption of the governance system to changes is not a sole mandate of any single actor level, but requires multi-level action that we find is delivered by the co-management model. This has, however, also enabled other Icelandic parks to follow and adapt their EGSs.

What we find as an obvious drawback of this diversity is its lack of coordination and dispersed park administration capacity. As a consequence of site-specific legislation, the PA estate has become somewhat scattered with the decision-making powers and mandates spread across independent PA administrations and the Environmental Agency. Equally, the executive power and day-to-day management capacity is spread between different administrations. This risks overlapping roles and replication of labour, and can manifest in skill and capacity gaps.

Following our analysis, our main policy recommendations are that allowing for PA governance system diversity and site-specific arrangements can be essential to facilitate legitimacy of the areas, manifested at the input level during their establishment stage. Site-specific legislations and administrations can, however, be counterproductive and negatively impact their legitimacy at the output level, as the diversity may lack structures for coordination as our respondents stated, and result in underperformance due to flaws in the governance systems and lack of capacity within each park unit.

There is a necessity to secure coordination and coherence between the diverse PA systems in order to secure their capacity and fitness to meet diverse governance challenges, as Iceland's booming tourism sector has exposed. In the case of Iceland, this could be achieved with a merger of the agencies into a park service allowing governance diversity but securing a stronger shared vision, greater capacity and more coordinated measures in day-to-day management.

These implications are important for Iceland and beyond as it seeks to continue expanding its PA area estate and provide effective and equitable governance, capable of adapting to emerging management challenges.

5. Endnotes

We use a generic expression of Minister/Ministry for Environment to refer to the Minister/Ministry in charge of protected areas.

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Appendix A

Outline of the guiding questions for in-depth interviews with park managers:

- Do the current Acts and bylaws that define governance of your protected area provide you with necessary legal tools for effective tourism management? If not, what amendments to the law or bylaws would you see necessary?
- Is the management plan a useful tool for your protected area regarding visitor management? How are you using it (if any) to support visitor management?
- Who are your most important stakeholders regarding park management? How do your interactions with them support governing the park?

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Paper II

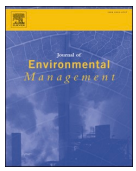
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Research article



Evaluating economic impacts of protected areas in contexts with limited data; the case of three national parks in Iceland

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ABSTRACT

Economic impacts of protected areas (PAs) are receiving more attention in recent years and methodology in this area is advancing. Multiple studies have illustrated that PAs are a potent land use strategy to generate multiple and direct economic benefits. These benefits are driven by tourism as the central economic activity in PAs worldwide. This study takes the case of Snæfellsjökull, Vatnajökull and þingvellir National Parks (NPs) in Iceland, characterized by limited regional economic data and multi-destination and -purpose visitor travel patterns. Its main objective is to advance understanding of the economic impacts related to PAs in the context of limited data availability. Our analysis is based on the widely used Money Generation Model (MGM2) -methodology, localized to the Icelandic context by using Icelandic labour data and national input-output (I–O) tables regionalized using the Flegg Location Quotient (FLQ). We provide a consistent approach for handling multi-destination and -purpose trips, and separating spending data between local and overall impacts. Based on 2019 visitor and economic data, the visitors (N = 2087) spent, on average, $113 per day in the parks and generated estimated total economic impacts between $30–99 MM with 347–1140 jobs generated across the study sites. For example, in Vatnajökull NP's southern region, the jobs supported locally by the park constituted 36% of all the jobs in the municipalities. Combined tax revenue to the state from the three parks was $88 MM. The localized methodology generated similar economic impacts as earlier studies but showed that employment impacts were previously overestimated by the default models. Our approach and findings can be used as a reference for others applying the MGM2 or similar methods, and they support policy development, decision-making and informed discussion between researchers, practitioners in PA and tourism management, municipalities and communities around PAs. Being able to show economic impacts is increasingly important for PAs to ensure sustained funding amid budget cuts and the transition of government bodies to business units. Limitations of the study include a lack of winter data for Vatnajökull and þingvellir NPs and broad categorization of the Icelandic economic data used in the I–O table regionalization. In further research, a comprehensive sustainability analysis is needed to complement the economic impact analysis and site-specific factors could be analysed in more detail.

1. Introduction

The impacts of protected area (PA) designations are a topic of increasing interest across the world; on the one hand combating loss of biodiversity and natural habitats, and on the other, acting as a driver for economic and regional development, especially in rural and peripheral settings in decline due to urbanization and industrialization (Briedenhann and Wickens, 2004; Maxwell et al., 2020; Naughton-Treves et al., 2005). The International Union for Conservation of Nature (IUCN) has defined tourism and recreation and local economic development as one of the key objectives of National Parks (NPs) in their classification of PAs (Dudley, 2008; IUCN, 1998), and economic impact analyses are increasingly becoming invaluable tools for policy and decision-making as a justification for continued maintenance and expansion of PAs (Child, 2014; Stynes, 2005). PAs needs active management and necessary political and financial support to ensure effective management, achieve conservation outcomes and prevent them from becoming "paper parks" (Kolahi et al., 2012, 2013). Part of the recent emphasis on the economic benefits of protected areas is linked to the constriction of public budgets, transformation of public services to business units expected to pay for themselves, and competition from the extractive industries which are more easily able to show direct monetary benefits, e.

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g. (Kolahi et al., 2014). The Convention for Biological Diversity (CBD) is advocating for stronger links between economic impacts and conservation outcomes by focusing on money generated by PA tourism that can 'attract support locally, carry political weight with governments and help influence policies' in order to overcome the negative trends (Stolton et al., 2021, p. 4).

A growing body of literature has demonstrated the high economic value of PAs globally (Balmford et al., 2015), nationwide in countries such as Australia, Brazil, Costa Rica, Finland, Canada, Germany, Nepal, Thailand and USA (Andam et al., 2010; Cullinane Thomas and Koontz, 2021; den Braber et al., 2018; Driml, 2010; Finnish Forest Research Institute, 2023; Heagney et al., 2015; Mayer and Woltering, 2018; Parks Canada Agency, 2011; Souza et al., 2019), and locally on an individual park level in many more countries, e.g. the Bahamas, Chile, Netherlands, Rwanda, South Africa, Spain, UK, Zambia (Arkema et al., 2021; Banerjee et al., 2018; Cairngorms National Park, 2020; Cerda et al., 2013; Chidakel et al., 2021; Chidakel et al., 2020; Hein, 2011; Huhtala, 2007; Hyde and Midmore, 2006; Lundmark et al., 2010; Martin Barroso et al., 2022; Mayer et al., 2010; Planagumà and Marti, 2018; Robalino and Villalobos, 2015; Saayman and Saayman, 2006a, 2006b; Saayman et al., 2009; Strickland-Munro and Moore, 2013). These economic impact analyses show that protected areas should not be regarded as economic black holes in the otherwise productive landscapes, but as potent resource use instruments capable of generating significant economic outputs. However, how exactly the economic impact is being analysed in the context-dependent and case-specific PA settings needs far greater attention.

The Money Generation Model (MGM) was one of the first applications to estimate the regional economic impacts of visitor spending on the US National Parks using this approach in mid-1990s, superseded by MGM2 adding on visitor segmentation, sectoral spending and indirect effect multipliers for different kinds of regions (Stynes et al., 2000). The MGM2 application also provided a set of default multipliers from different contexts to estimate secondary impacts for areas without dedicated regional economic models, and region-specific multipliers could be added, thus it has been used internationally (Kajala et al., 2007, pp. 136-137, Kajala, 2012; Souza et al., 2018; Souza, 2016). However, the regional economic data needed for this is often lacking as it is expensive to collect, and sometimes no primary data for the compilation of regional economic tables exist (Lampiris et al., 2020). Many countries are producing input-output (I–O) tables regularly as part of national accounting, and non-survey methods for regionalizing these I–O tables have developed quickly, providing low-cost options with reasonable accuracy (Tohmo, 2018).

The overall objective of this study is to advance understanding of the economic impacts related to PAs in the context of limited data availability. We provide a case study of the three Icelandic NPs using the adapted methodology that will support informed decision-making on local and national level. Comprehensive use of local economic data is a significant advancement from previous studies (Siltanen, 2018). We believe the methodological guidelines and discussion are relevant in the wider context for researchers, practitioners and policy makers who are adapting general economic impact methodologies to their datasets in other states. We approach the overall objective with the following research questions (RQs).

1. What is understood by local and national economic impacts of PAs?
2. How can we adapt the MGM2 methodology for the Icelandic context, taking into consideration local tourism travel patterns and local economic data?
3. What are the economic impacts of example NPs in Iceland?

2. Materials and methods

2.1. Study sites

Our study takes the case of Iceland, a country with around 130 PA units covering more than 26% of its terrestrial area, including three national parks (Environmental Agency of Iceland, 2021; Petursson et al., 2016). It saw a dramatic rise in tourism prior to the COVID-19 pandemic with visitor numbers increasing from ca. 500,000 to over 2 million between 2010 and 2019 (Icelandic Tourist Board, 2021). 92.4% of the visitors stated that nature is the main reason for the visit (Icelandic Tourist Board, 2018). In 2019, tourism accounted for 35% of all exports (Icelandic Chamber of Commerce, 2020), and as most of Iceland's natural attractions are in sparsely populated rural areas with limited industries and economic activities, the government has actively emphasized and supported nature-based tourism in rural areas to keep them viable by expanding the PA network (Siltanen et al., 2022).

As with many other small and/or sparsely populated states, regional economic data in Iceland is scarce; for example, Eurostat (Eurostat, 2022) counts Iceland as one region, complicating the production of official regional statistics. As a result, previous studies on related topics have either been carried out with time-consuming and limited coverage primary surveys or conservative defaults, e.g. (Rögnvaldsdóttir, 2016, pp. 14-18; Siltanen, 2018). Recent releases of new national I–O tables and regional employment datasets with emerging research on location quotients suggests that it is now feasible to use non-survey methods to regionalize I–O tables for Iceland to get more accurate estimates of the local economic and employment impacts (Flegg and Tohmo, 2018; OECD, 2019). Such estimates are important for the understanding of rural development and to inform decision-making as many rural communities in Iceland have struggled with long-term depopulation and the decline of the more traditional fishing and agriculture economic activities (Sæþórsdóttir and Hall, 2019). Visitor travel patterns are also distinctive in Iceland, characterized by multi-destination and -purpose trips (Martínez-Espiñeira and Amoako-Tuffour, 2009), warranting further methodological discussions and decisions in comparison to standard MGM-approaches.

Our analysis covers the three Icelandic national parks of Þingvellir (ÞNP), Snæfellsjökull (SNP) and Vatnajökull (VNP) based on their IUCN designation, popularity as major tourism destinations and distinct geographical locations around the country (see Fig. 1). They provide visitors with free access all-year round, but many locations within the parks are closed during winter. Due to the vast size and distinct regions of VNP, we will limit this study to the most popular and accessible southern region of the park that is one out of the four formal administrative units within the larger park (Petursson and Kristofersson, 2021).

ÞNP covers 237 km^2 and is centered around a historical parliament site in a unique rift valley between tectonic plates. It is also a UNESCO World Heritage Site (WHS) and in the vicinity of the capital – ca. 50 km from Reykjavík. SNP (170 km^2) is characterized by a glacier-capped volcano and unique landscapes by the sea, located ca. 200 km from Reykjavík. The southern region of VNP hosts several famous glacial lagoons and hiking areas between the glacier and the sea, and is situated ca. 350 km from the capital. VNP covers 14,141 km^2 and is also a UNESCO WHS. 'Strengthening the settlements and economic activities' is a legally-binding objective of VNP (Icelandic Parliament, 2007). A detailed overview of the sites and data collection approaches is provided in Table 1.

The study builds on prior studies regarding the economic impacts of nature-based tourism in Iceland. Following the tourism boom, a case study applying the MGM2 methodology to the economic impacts of SNP was conducted (Siltanen, 2017), followed by a larger nationwide study covering 11 additional PAs and other natural attractions (Siltanen, 2018). In these studies, the MGM2 methodology was used with conservative default economic multipliers, as the necessary regional Icelandic data was not yet available.

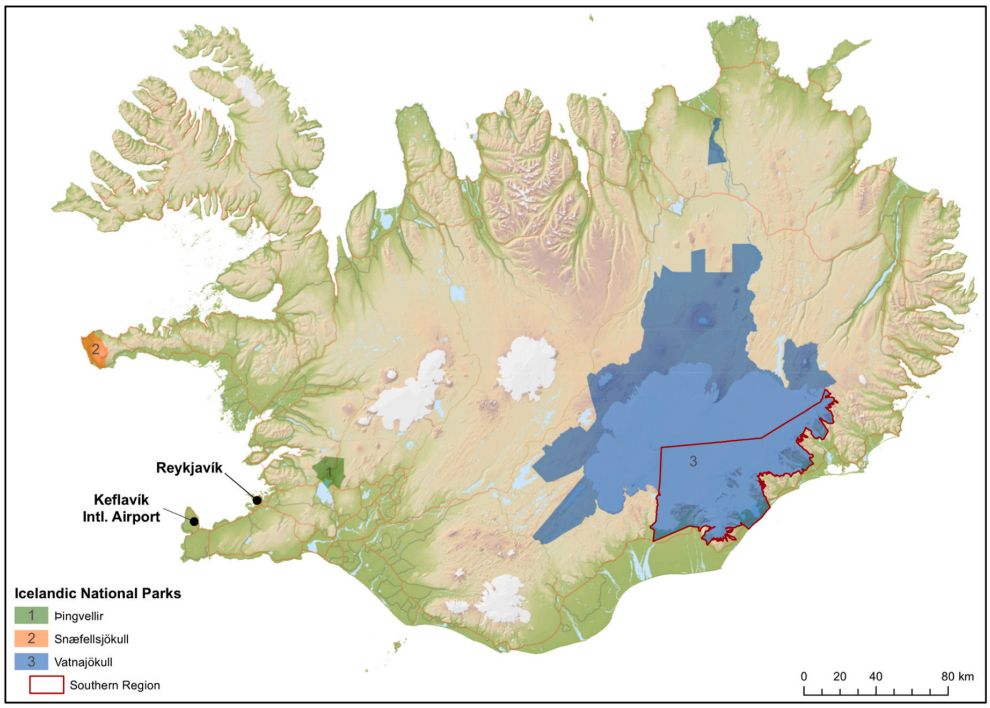


Fig. 1. Map of the research sites.

Table 1
Overview of the research sites.

Site	Key feature(s)	Survey collection locations and timing	Visitor profiles	Visitor numbers (2019)
Vatnajökull NP (South region) *Skaftafell, Jökulsárlón & Fjallsárlón and Heinabergslón* 14,141 km^2 *(whole park)*	Popular sites and main visitor centers in southern Vatnajökull NP, near the glacial lagoons and several glacial outlets. Many hiking routes to the surrounding mountains and glacier edges.	Skaftafell visitor center and campsite. Jökulsárlón & Fjallsárlón glacial lagoon visitor centers and parking lots. Meeting point for Heinabergslón kayaking tours. Summer 2018 & 2022.	Independent travelers by car. Tour buses from Reykjavik. Both day visitors sightseeing the glacier edges and glacial lagoons, and hikers staying in the area longer. Lots of organized tour activity in the area.	South region: Jökulsárlón: 935,572 Fjallsárlón: 264,238 Heinabergslón: 13,301 Skaftafell: 694,268 (G. Þórhallsdóttir & R. Ólafsson, email, February 23, 2022)
Snæfellsjökull NP 170 km^2	Snæfellsjökull glacier and volcano. Unique volcanic landscapes by the sea.	Malarrif visitor center, parking lot at Djúpalónssandur. Summer and winter 2017.	Independent travelers by car. Tour buses from Reykjavik. Mainly sightseeing location but also day hikes available.	410,991 (J. Björnsson, email, March 23, 2022)
Þingvellir NP 237 km^2	Historical parliament site, and rift valley between tectonic plates. A UNESCO World Heritage site.	Visitor center (Hakið), information center campsite, parking lots P2, P3, P5 and Silfra. Summer 2018 & 2022.	Independent travelers by car. Tour buses from Reykjavik. Typically, part of Golden Circle tour and sightseeing visitors, but also hiking trails provided.	1,336,712 (G. Þórhallsdóttir & R. Ólafsson, email, February 21, 2022)

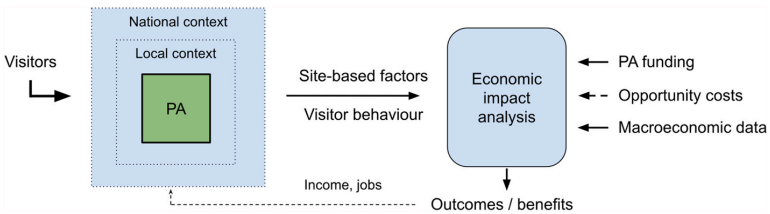


Fig. 2. Economic impact analysis overview.

2.2. Analytical framework

We have provided an overview of the analytical context of this study in Fig. 2. The number of visitors to each PA is the primary factor directly affecting the economic impacts, but visitor spending at each site can also vary due to site-based factors and visitor behavior (e.g., length of stay, seasonality and accessibility, availability of commercial tours or concessions), significantly affecting the economic impacts. Visitor numbers and spending is then combined with regional macroeconomic data to estimate the secondary impacts in the value chain. Outcomes and benefits are realized in value-added, personal income, tax revenue and jobs. Opportunity costs, investments and operational funding also need to be taken into consideration when comparing the outcomes to other land-use options or between PAs; a recent framework for mapping synergies and conflicts between land uses can support this task (Kangas et al., 2022). However, such analysis is beyond the scope this paper.

Most PA economic impact studies focus either on the local or national context. We analyze the economic impacts on both levels: the local context, defined as a 50 km radius from the park location to evaluate the contribution to the local economy (Stynes, 1999), and the national context for any visitor spending outside the park vicinity, to evaluate the wider macro-economic impacts. Naturally, the economic benefits generated in the vicinity of the parks are an important factor for local support; and in the case of VNP is even a legally-binding objective (Icelandic Parliament, 2007).

In Iceland, however, we find the national context also relevant for several reasons: 1) Nature-based tourism is the largest export industry in the country and thus has major macroeconomic and tax revenue significance; 2) Circa 99% of tourists arrive in the country via Keflavík International Airport (Icelandic Tourist Board, 2022), and purchase many relevant services (e.g. rental cars or tours) regarding the national park visits from either this facility or the capital region – roughly half of their total spending related to park visits according to earlier research (Siltanen, 2018). This spending would be omitted if we only focused local spending; and 3) Tourist travel patterns in Iceland are quite unique, with visitors often travelling around the country on the ring road, and thus it depends on many factors if they stay overnight in the vicinity of the park during their visit.

2.3. Economic impact analysis

2.3.1. Recreational experience valuation and MGM2

Recreational experience valuation methods traditionally measure visitors' willingness-to-pay by revealed preference -approaches such as market price and travel cost methods (TCM), or stated-preference approaches such as contingent valuation (CV) and choice modelling (CM) that also capture non-use values (Mayer and Job, 2014). TCM, CV and CM are examples of non-market valuation techniques (NMVTs), which attempt to identify individual micro-economic value that is not traded directly in the market. Economic impact analyses, such as MGM2, go beyond analysis of the individual value of a natural experience and calculate how economic activity from visitor spending affects the regional economy by incorporating visitor statistics, market and surrogate market value (via TCM) with a regional economic model, e.g., input-output (I–O) tables, social accounting matrices (SAM) or computable general equilibrium (CGE) models (Stynes, 2005). The MGM2 methodology was recommended as a way to follow local employment and economic impacts when VNP was opened, and visitor spending data was collected during the first year of operation by visitor surveys; however, the economic impacts were not analysed at that time (Sigurgeirsdóttir and Árnason, 2008, pp. 18-20; Welling, 2008).

MGM2 is based on multiplication of the number of visitors in each visitor segment with average segment spending, and economic multipliers that account for the indirect effects (Stynes et al., 2000). Economic impacts are provided in sales, income, jobs, tax receipts and value added, and further distinction is made between direct, indirect and induced effects (Stynes et al., 2000). Direct effects are comprised of goods and services purchased by visitors. Indirect effects are comprised of goods and services bought by tourism companies from their suppliers. Induced effects represent the spending of employees and companies in the tourism sector through wages and profits from tourism businesses; however, due to limitations in the economic data in Iceland, we are not able to calculate the induced effects in this study. The MGM2 method provides default multipliers for parks in different contexts, typically derived from local input-output (I–O) tables or GCE models and describing the structure of the local economy (Kumar and Hussain, 2014; Stynes et al., 2000). However, the default multipliers are calculated for the US context and are not necessarily transferable to other countries, and thus we used regionalized national input-output tables to calculate the multipliers for this study, and local capture and tax rates (see Appendix A, Table 6).

2.3.2. Regionalization of I–O tables

Input-output tables describe the structure of a national or regional economy by providing a transaction matrix detailing how each sector is depending on purchases from itself or other sectors for a given output; these purchases are called intermediate inputs, and imports and salaries are primary inputs (Flegg et al., 1995). Instead of direct monetary purchases, the matrix can also be expressed as purchase coefficients i.e. an inverse Leontief-matrix, indicating the shares of inputs between different sectors for a given output. The sum of each column in the inverse matrix presents the output multiplier for each sector (Hewings, 2020).

Different types of I–O tables exist; Type A tables describe total demand including imports, and Type B tables separate between domestic production and imports (Flegg et al., 2021). Our analysis focuses on I–O tables with domestic production, as we are interested in the value-added that is generated in Icelandic PAs. When we are regionalizing a national I–O table, one of the key issues is to account for regional trade and domestic imports. Purchases in each region generate added value locally for the part not based on regional imports. Location Quotients (LQ) are a popular method to account for this, and they have been used in calculating economic impacts of PAs, for example, in Finland (Huhtala, 2007; Huhtala et al., 2010; Vatanen and Lajala, 2019), Sweden (Kronenberg and Fredman, 2022) and Spain (Martin Barroso et al., 2022).

Many variants of the LQ-methodology exist; in general, they use regional employment or production figures relative to national figures to scale down sectoral coefficients and account for imports from other regions. Earlier LQ-methods include simple LQ (SLQ) and cross-industry LQ (CILQ), defined as follows (Flegg and Tohmo, 2016):

$$SLQ_i = \frac{RE_i/TRE}{NE_i/TNE} = \frac{RE_i}{NE_i} \times \frac{TNE}{TRE} \quad (1)$$

$$CILQ_{ij} = \frac{SLQ_i}{SLQ_j} = \frac{RE_i/NE_i}{NE_j/NE_j} \quad (2)$$

RE_i and RE_j refer to regional employment in the supplying sector i and purchasing sector j, and NE_i and NE_j are corresponding national figures. TRE and TNE correspond to regional and national employment totals. Instead of employment, production figures can also be used, eliminating potential distortion from productivity variation between regions (Flegg and Tohmo, 2019). National input coefficients in the inverse matrix can then be multiplied by SLQ_i or $CILQ_i$ to obtain regional coefficients. However, there is substantial evidence that the original LQ methods like SLQ and CILQ overestimate regional multipliers, and the FLQ method was developed to address this (Bonfiglio and Chelli, 2008; Flegg & Tohmo, 2013, 2016, 2019; Flegg et al., 1995). FLQ is defined as (Flegg and Tohmo, 2016):

$$FLQ_{ij} = CILQ_{ij} \times \lambda^*, for\ i \neq j \quad (3)$$

$$FLQ_{ij} = SLQ_i \times \lambda^*, for\ i = j \quad (4)$$

where

$$\lambda^* = [log_2(1 + TRE/TNE)]^{\delta} \quad (5)$$

; $0 \leq \delta < 1$ and $0 \leq \lambda^* < 1$.

As above, TRE and TNE can be replaced with total regional and national production figures. Restriction FLQ ≤ 1 is used to ensure it can only be used to scale down national coefficients (Bonfiglio and Chelli, 2008). FLQ should only be used with Type B tables where imports have been excluded (Flegg and Tohmo, 2013). Augmented FLQ (AFLQ) was developed to account better for regional specialization. However, in most cases it was found to produce similar estimates as FLQ (Flegg et al., 2021; Flegg and Webber, 2000). We chose to calculate both FLQ and AFLQ multipliers in this study; FLQ as the base methodology, and AFLQ to see if it would reveal interesting features related to regional tourism development in Iceland, as it allows for local upscaling of multipliers (Bonfiglio and Chelli, 2008; Flegg and Tohmo, 2013).

$$AFLQ_{ij} = FLQ_{ij} \times \lambda^* \times \left[log_2\left(1 + SLQ_j\right)\right], where\ \lambda^*\ as\ above. \quad (6)$$

Selecting an optimal δ in the FLQ and AFLQ methods is not easy; a higher value allows for more interregional imports and thus a more conservative regional output. Recently, a range of $\delta = 0.3 \pm 0.1$ has been recommended (Jahn et al., 2020; Lahr et al., 2020). We chose to use the recommended $\delta = 0.3$ for þingvellir NP due to its capital region vicinity, and a more conservative $\delta = 0.4$ for VNP South and SNP regions as these are less populated and remote regions, and are more dependent on imports.

2.4. Data collection

2.4.1. Visitor counting data

There are well-established guidelines in the Nordic context for collecting data on visitor numbers and expenditure (Kajala et al., 2007, pp. 37-118). Accurate visitor numbers are the most important factor for precise economic impact analysis (Stynes et al., 2000), so having reliable long term visitor counter data was a pre-requisite for the chosen sites in this study. These visitor numbers are based on magnetic vehicle counters that are calibrated by manual hand-counting during a calibration period (þórhallsdóttir and Ólafsson, 2017). In this study, we will use the visitor numbers from 2019, presented in Table 1 as a baseline for the economic impacts, as the period 2020–2022 was impacted by the COVID-19 pandemic.

2.4.2. Visitor spending data

Visitor expenditure was collected at each location by non-probability convenience sampling (Etikan et al., 2016), i.e. during the surveying days, effort was made to approach all passing visitors, inform them briefly of the survey and ask them to participate. The surveys were collected using an electronic survey form accessible with a provided tablet or visitors' mobile phone and QR-code. A paper alternative of the survey was also available in case of no internet connectivity or visitor preference. The survey design followed recommendations of a Nordic and Baltic working group (Kajala et al., 2007, pp. 178-179) with some local adjustments and harmonization steps as described in Appendix B (Siltanen, 2018).

The times and locations of the survey collection are provided in Table 1. Additional visitor spending data was collected in þingvellir NP and Vatnajökull NP during summer 2022 to increase the sample sizes, check for any differences between visitor data between 2018 and 2022, and to form a comprehensive dataset for Vatnajökull NP's southern region. All visitor spending data was adjusted to July 2019 values based on the consumer price index. Generally, the data collector was always present when visitors were filling out the survey, able to answer questions and provide clarifications, and in some cases collected the data by interviewing the visitor through the survey and filling out the form based on the verbal answers. As a result, the number of discarded responses due to missing or inconsistent data was low; 90% of the pilot study responses and 99% of the main study responses were considered valid. The difference in the rate of valid responses is due to an improved form based on pilot study results and very few unsupervised surveys in the main study. All sample sizes include only valid surveys.

Seasonality is a significant issue for tourism in Iceland, especially for nature-based tourism outside of the capital region. Visitor spending data for SNP was collected as part of a pilot study in 2017, with both winter and summer samples. The rest of the visitor data was collected in 2018 and 2022 during the summer season, so there is a bias towards summer visitors at þNP and VNP. However, findings from the pilot study indicated that the overall spending for visitors at SNP was similar between summer and winter periods (Appendix B).

MGM2 uses visitor segments to increase the accuracy of the analysis (Stynes et al., 2000). In our case, there was no comparable previous data from the visitors or their segments, so primary data was collected from all sites and visitors classified according to the following segments: non-resident day visitors, non-resident visitors with indoor accommodation, non-resident camping visitors, and Icelandic residents (Appendix B). Residents from the vicinity of each site were excluded as their spending does not bring new money to the area. Sample sizes per visitor segment are presented in Appendix B. Overall, valid responses were collected from 2087 people with individual site-based samples. All samples were statistically valid at the 95% confidence interval (CI) using the Dillman formula (Dillman, 2011; Oribhabor and Anyanwu, 2019).

There are certain features about visitor travel patterns in Iceland that necessitated further adjustments to data collection. The most evident is the visitor tendency to visit several sites per day as many PA attractions in Iceland are part of popular sightseeing routes, further emphasized by the large number of organized tours to many sites. As a result, visitor length of stay on average is much shorter than in PAs in other countries; based on the data we collected for this study, only 1 day (Appendix B, Table 7), which is much lower when compared to the 5–7 days reported in a pilot study in Finland (Huhtala, 2007), We therefore needed to consider how long the actual stay is and which 'part of the day' we can count towards the economic impact of a single PA. The TCM literature refers to such situations as multi-destination spending or multi-purpose trips, and recommends weighing the spending based on visitor time and/or rationale (Leh et al., 2018; Martínez-Espiñeira and Amoako-Tuffour, 2009). We used a survey design combining national park affinity and other visited sites during the day (Huhtala et al., 2010), including all spending for those visitors for whom the NP was the only or most important destination and excluding all visitor spending for whom the NP was a non-planned destination. For the majority of the visitors, NP sites were one of many visited sites during a day and in such cases the visitors' spending was divided by the total number of site visits in a 24 h period, using only a fraction of the spending for the NP in question.

Tourism travel patterns and shorter stays at individual sites also complicate the handling of visitor spending at a PA site versus elsewhere. In general, economic impact analyses using the MGM2 are concerned with local spending only; how the parks generate income and employment in the vicinity. This is a reasonable point of departure when the visitors stay several days in or around a PA and do all their business in the area. However, with a 1.0 day average adjusted stay in our study, it is more likely visitors will spend the night before or after visiting a site outside the immediate vicinity of the area, perhaps near the next PA or another nature attraction. Thus, visitor spending also outside the vicinity of a PA is relevant, both for the PA and the macroeconomic effects of PA tourism. Capturing expenses, both locally and elsewhere, makes the survey more complicated for the respondents if filled out unsupervised (Huhtala et al., 2010), but as the surveys in this study were mainly collected supervised, this did not become a major issue (Siltanen, 2018). Due to þingvellir NP's proximity to the capital region, only overall economic impacts were calculated, as the edge of the capital region is within a 50 km radius of the park and almost all services related to þingvellir visits are purchased from the capital region (Siltanen, 2018).

2.4.3. Icelandic I–O tables

We used the Icelandic national Type B input-output table from 2018 as base data for the regional input-output tables (OECD, 2021). This I–O table provides separate matrices for domestic intermediate purchases and imports using a classification of 45 sectors including value-added, taxes and total output for each industry. The classification is based on NACE v.2 and ISIC v.4 sector classification (International Labour Organization, 2022). The Icelandic employment data from the Labour Force Survey uses the NACE v.2 compatible Icelandic ÍSAT2008 activity classification (Statistics Iceland, 2009). The Labour Force Survey provides monthly numbers of employees and taxable wages per industry on a municipal level since 2008 (Statistics Iceland, 2022c).

However, the Labour Force Survey uses only 12 categories of economic activity, primarily based on the main sector headings, and in some cases the sectors are combined with similar sectors (e.g. public administration, health, education and social work are grouped together). Thus, the OECD I–O table needs to be aggregated to match the same classification before the regionalization methods can be applied. Aggregation of the domestic I–O matrix was carried out using the Aggregation Matrix MATLAB function (Stair, 2013); the sum of imports in each column was used together with the taxes and value-added to calculate an aggregated domestic input-coefficient matrix.

An input-coefficient matrix describes the proportion of inputs from each of the other sectors (plus imports and value-added) in relation to the total output of a given sector; Leontief inverse matrices are calculated from the input-coefficient matrices using equation (7), allowing sectoral multipliers to be calculated as a sum of each column (Hewings, 2020). If the I–O table includes household spending as one of the demand columns, and salaries are separated from total value-added as a separate supply-side row, these can be treated as a separate sector and included in the aggregation and input coefficient matrices to allow Type II multipliers, including induced impacts, to be calculated from the Leontief inverse matrices (Miller and Blair, 2022). However, as salaries are not separated from value-added in the Icelandic national input-output table (OECD, 2021), it was not possible to calculate the induced impacts.

$$L = (I - A)^{-1}, \textit{where } I \textit{ is an identity matrix and } A \textit{ is the input coefficient matrix.} \quad (7)$$

Taxable wages were aggregated from the Labour Force Survey for municipalities within ca. 50 km radius of each national park location (Statistics Iceland, 2022c; Stynes, 1999); see Appendix C. Capital region municipalities are on the edge of the 50 km boundary for þingvellir NP, and these were included as most tourism activities related to the park are operated by businesses in the capital region. First, industry-specific SLQs were calculated for these regions using (1), then CILQs (2), enabling the calculation of FLQs for all locations using (3)–(5). Further, AFLQs (6) were calculated, allowing regional sectors also to be upwardly adjusted in regions where certain sectors are particularly prominent. Input coefficient matrices were adjusted using both the FLQ and AFLQ methods and Leontief inverse matrices calculated via (7), facilitating the retrieval of sectoral Type I indirect impact multipliers, and a comparison of the FLQ and AFLQ methods in the Icelandic context.

2.4.4. Localized employment multipliers

In addition to the economic impacts, the MGM2 methodology contains default employment multipliers for different contexts. However, these are based on the US economy, and may not match European economies where the cost of employment is often higher for employers, e.g. (Peters, 2008). In order to calculate the employment impacts of visitor spending in Iceland, we divided the VAT-corrected domestic turnover of companies by the total number of both full-time and all employees in each sector (Statistics Iceland, 2022b; 2022d). This ratio enabled us to calculate the indicative number of jobs generated by direct and indirect visitor spending. As company turnover data is not available on a municipal level in Iceland due to confidentiality concerns, we were only able to calculate domestic employment multipliers.

2.4.5. Tax revenues

Tax revenue is an important source of PA funding on a national level (Spenceley et al., 2021). We calculated sales tax revenue based on standard VAT rates (Appendix A). Income taxes were calculated based on the number of generated jobs, main income tax bracket with a 100% personal tax credit for full-time jobs and 50% tax credit for part-time jobs plus payroll tax (Icelandic Tax Authority, 2022), using a median of total regular earnings for full-time jobs and a median of regular earnings for part-time jobs' salaries for each sector in 2019 (Statistics Iceland, 2022a). Value-added tax revenue was calculated using capital gains tax for the remainder of the captured sales after salaries have been paid (Icelandic Tax Authority, 2022). Municipal property taxes are not included in these figures.

3. Results and discussion

3.1. Type I economic impact multipliers

Table 2 presents the Type I indirect effect multipliers calculated for the capital region, vicinity of the NPs in the study and the national level for comparative purposes. The mean of non-adjusted domestic multipliers is 1.50, while the regionally adjusted multipliers are between 1.21 and 1.35. They match closely with the conservative default multipliers (1.17–1.29) used in previous case studies in Iceland (Siltanen, 2018), and are slightly higher than Type I multipliers (1.08-1-14) calculated in a recent Swedish study (Kronenberg and Fredman, 2022). However, compared to Type II multipliers presented in other economic impact studies (e.g. 1.50–2.0 in Finland (Vatanen and Lajala, 2019), or 1.36 for agriculture and 3.2 for travel and tourism in general (Waldron et al., 2020)), these are quite low.

Concerning the differences between the FLQ and AFLQ methods, Table 2 shows the only significant upward adjustments by the AFLQ in the hospitality and agricultural sectors in VNP's southern region, increasing FLQ-adjusted multipliers from 1.36 to 2.30 and 1.14 to 1.37, respectively. This suggests good sensitivity of the AFLQ method as the Skaftárhreppur and Hornafjörður municipalities have rapidly transformed in recent years from primarily agricultural areas to centers for glacier tourism (Sæþórsdóttir and Hall, 2019; Welling, 2020). Regardless, we have calculated the economic impacts of the NPs in this study using multipliers adjusted by the more conservative FLQ method. However, the AFLQ results suggest it may be an interesting alternative for specific case studies in the future.

3.2. Employment multipliers in Iceland

Table 3 provides the ratios of generated jobs per sales turnover for each sector, calculated from the Icelandic economic data. We have provided reference figures in million USD in addition to Icelandic krona in order to be able to compare the multipliers to previous studies; exchange rate 1 USD = 141.23 ISK (Central Bank of Iceland, 2022). However, all economic and employment impact calculations are carried out in krona to remove the effects of currency fluctuations.

Table 3 shows that the USD-based employment multipliers vary between 1.7 (energy and water supply sector) and 15.5 (transport sector) for main jobs. The accommodation sector is at 7.8, food services at 12.0, retail at 2.7, construction and manufacturing at around 4.7–4.9 and agriculture at 9.1. Figures for all jobs, including part time jobs, are 5–17% higher for sectors directly involved in tourism. These findings are in line with previous studies; for example, the sectoral average in a similar Swedish study was 8 jobs, and between 8 and 17 jobs in Finland and 5–30 jobs in the US (MGM2, Type I) (Kronenberg and Fredman, 2022; Stynes et al., 2007; Vatanen and Lajala, 2019). Inflation and currency fluctuations affect these comparisons, but the range is similar.

Table 2
Sectoral Type I multipliers using FLQ and AFLQ adjustments.

Sectoral multipliers	Domestic	Þingvellir (+50 km)		Snæfellsjökull (+50 km)		VNP South (+50 km)		Capital region	
Adjustment method	*Non-adjusted*	*FLQ*	*AFLQ*	*FLQ*	*AFLQ*	*FLQ*	*AFLQ*	*FLQ*	*AFLQ*
Crop and animal production, and forestry and related service activities	1.61	1.46	1.47	1.09	1.11	1.14	1.37	2.18	2.20
Manufacturing	1.60	1.24	1.25	1.21	1.21	1.49	1.56	1.24	1.24
Energy and water supply	1.44	1.18	1.19	1.12	1.14	1.10	1.11	1.19	1.19
Construction, mining and quarrying	1.57	1.27	1.27	1.16	1.16	1.09	1.10	1.28	1.28
Wholesale and retail trade; repair of motor vehicles and motorcycles	1.36	1.15	1.17	1.09	1.09	1.14	1.16	1.15	1.17
Transporting and storage	1.48	1.23	1.24	1.11	1.10	1.14	1.16	1.23	1.23
Accommodation and food service activities	1.57	1.25	1.25	1.12	1.15	1.36	2.30	1.26	1.26
Information and communication	1.53	1.23	1.29	1.94	1.94	1.79	1.90	1.23	1.29
Financial activities and other specialized activities	1.41	1.18	1.20	1.12	1.11	1.10	1.11	1.18	1.20
Professional, scientific and technical activities	1.45	1.19	1.23	1.12	1.12	1.13	1.15	1.19	1.23
Public admin., Education, Human health and social work activities	1.47	1.26	1.27	1.32	1.34	1.21	1.20	1.26	1.26
Other activities	1.47	1.20	1.21	1.13	1.12	1.10	1.11	1.20	1.21
Mean	*1.50*	*1.24*	*1.25*	*1.21*	*1.22*	*1.23*	*1.35*	*1.30*	*1.31*

Table 3
Employment multipliers.

Employment impacts by VAT-adjusted domestic sales (2018)	Main job Jobs/ mISK	All jobs Jobs/ mISK	Main job Jobs/ mUSD	All jobs Jobs/ mUSD	Difference All vs. main
Crop and animal production, and forestry and related service activities	0.065	0.068	9.1	9.6	+5%
Manufacturing	0.034	0.036	4.9	5.1	+5%
Energy and water supply	0.012	0.012	1.7	1.8	+7%
Construction, mining and quarrying	0.034	0.035	4.7	4.9	+3%
Wholesale and retail trade; repair of motor vehicles and motorcycles	0.019	0.021	2.7	3.0	+9%
Transporting and storage	0.110	0.115	15.5	16.3	+5%
Accommodation	0.055	0.060	7.8	8.5	+8%
Food services (restaurants, bars, cafes)	0.085	0.100	12.0	14.1	+17%
Travel agency, tour operator and other reservation service and related activities	0.036	0.039	4.5	5.0	+8%

3.3. Visitor spending

As discussed, visiting several sites and destinations within one day is typical of tourist travel patterns in Iceland. Hence, it is first necessary to look at the importance of each site visit to determine the share of the visitor spending that can be counted towards each study site. Table 4 presents the responses from all valid surveys. Overall, only 13.5% of the visits to each site were 'the only or most important destination' for the visitor on the day of the survey, and thus all visitor spending from these visits was included in the analysis. 83% of the visitors visited several sites during the day, and PA spending was calculated as a fraction of the total number of sites visited. 3.5% of the visits were non-planned and visitor spending from these was excluded from the analysis.

Table 4
National park affinity and average visitor spending at study sites.

National park affinity and spending	Snæfellsjökull (N = 501)	Vatnajökull South (N = 1005)	Þingvellir (N = 581)	Overall (N = 2084)
Only one or most important	11%	18%	7%	13.5%
One among multiple	82%	80%	90%	83.0%
Non-planned (excluded from analysis)	7%	2%	3%	3.5%
Average PA-only spending per day ISK (USD)	11,344 ($80)	21,780 ($154)	10,004 ($70)	16,000 ($113)
% spent locally	45%	51%	NA	NA

Table 4 also presents the average daily spending per visitor ($113) attributable to the NPs, varying between ca. $70–154 in þNP and VNP; both ISK and USD figures are provided for ease of reference (Central Bank of Iceland, 2022). Detailed visitor spending per segment is presented in Appendix B, Table 9. Roughly half of the overall spending was spent in the vicinity of the SNP (45%) and South VNP (51%), indicating local leakage rates of 55% and 49%. Some previous studies, e.g. (Hjerpe and Kim, 2007), found over 50% leakage from the rural areas surrounding the PA, a relatively poor result. However, in the Icelandic context, where the tourism services are concentrated in the capital region and very limited in rural areas, we find these shares encouraging.

3.4. Economic impacts

Table 5 presents a summary of the economic impacts of the NPs in the study based on visitor numbers in 2019 and economic data from 2018 (I–O tables) and 2019 (employment data).

Results in Table 5 show significant estimated economic impacts and generated jobs from all NPs in the study. Spending in the SNP supports 174 jobs locally and generates an economic impact of $14 MM within the Snæfellsnes Peninsula, 47% of the total impact. The southern region of VNP generates 681 jobs and $56 MM economic impact locally, 57% of the total. These job numbers may seem relatively small in comparison to other international studies. However, in the context of the surrounding municipalities having only a few thousand people in total, they are very significant employers locally. On the Snæfellsnes peninsula, local jobs supported by the park represent 6% of the working population, while in the municipalities surrounding VNP's southern region, this ratio is as high as 36% based on the 2021 census (Statistics Iceland, 2023a; 2023b). These employment impacts are similar to the tourism employment figures in these municipalities from the Icelandic Travel Industry Association (SAF) database,119[1] and 598 respectively (SAF, 2023), providing a source of verification for the localized MGM2 methodology. Plain tourism employment figures are expected to be somewhat below the MGM2 employment figures as MGM2 also includes indirect jobs generated in other sectors. It should also be noted that the methodology

[1] Tourism jobs figure from 2018 used for Eyja-og Miklaholtshreppur municipality as the data for 2019 is missing the SAF database.

Table 5
Summary of direct and indirect economic impacts of the study sites.

Site	Visitors 2019	Local jobs	Total jobs	Local sales	Local economic impact	Total sales	Total economic impact	Sales taxes	Income and value-added tax
		inc. Part-time		*In million ISK (million USD)*					
Snæfellsjökull	410,991	174	347	2925 (21)	1976 (14)	6527 (46)	4206 (30)	967 (7)	1134 (8)
VNP South	935,572	681	1140	10,526 (75)	7959 (56)	20,377 (144)	13,986 (99)	2710 (19)	3775 (27)
þingvellir	1,336,712	n/a	656	n/a	n/a	12,035 (85)	7975 (56)	1662 (12)	2156 (15)

largely excludes public jobs, such as staff employed by the parks, as there are no entrance fees and services paid directly to the parks are few in Iceland.

Overall, the parks generated a total economic impact of $30 MM for SNP, $99 MM for VNP South, and $56 MM for þNP, and support 347, 1140 and 656 jobs respectively. Combined sales and income taxes are $15 MM, $46 MM and $27 MM for SNP, VNP's southern region and þNP, respectively. Comparing these results to the summary of economic impacts in the previous Icelandic study (Siltanen, 2018), it is interesting to note that the economic impacts align quite closely for þingvellir and Snæfellsjökull's NPs. The total economic impacts with secondary effects were 59–60% of the total direct sales in 2018, and 64–65% in this study; the differences can be mainly explained by the adding of transportation services to the tours category and an update to the petrol purchases capture rate. There is no direct comparison for VNP's southern region as Jökulsárlón was not included in the previous study.

However, there is a clear difference in the employment impacts with the previous study, showing almost twice the number of jobs generated by conservative US-based multipliers compared to the new localized employment multipliers generated by the Icelandic labour data. This is likely at least partially due to the low overall number of part-time jobs in Iceland; as indicated by Table 3, adding all part-time jobs increased the job multipliers only by 5–17% depending on the sector, in comparison to full-time-only based multipliers. This is an interesting finding and may suggest that while sectoral Type I multipliers aligned well between the studies and localized versus default multipliers, there may be more regional variation in the labour markets and consequently employment multipliers.

4. Conclusions

We conducted an economic impact analysis by developing a localized version of the MGM2 methodology using primary visitor data and a combination of Icelandic domestic and regional economic data. We tested the methodology through the case studies of Snæfellsjökull, Vatnajökull (southern region) and þingvellir NPs. Visitor counts were provided by local tourism research institutes or the park employees themselves. Visitor spending data was collected by onsite surveys for each study location (total N = 2087). A domestic input-output table produced by the OECD for 2018 was regionalized using the FLQ-methodology, and employment multipliers generated from the Icelandic Labour Survey data. Multi-destination and multi-purpose trips were handled by counting all visitor spending towards the economic impacts when the park was the only or main visit for the day, excluding all spending for non-planned visits, and dividing the spending by the number of visits in the day for the rest. Using this approach, the average daily park-attributable spending was $113 and varied between $80-$153. Approximately half of the visitor spending took place in the vicinity of the park where applicable, emphasizing that visitors spend a significant share locally.

The results show significant economic impacts based on the visitor spending in these national parks. Local estimated economic impacts around Snæfellsjökull and Vatnajökull (southern region) NPs were circa $14 MM and $56 MM with 174 and 681 jobs generated, respectively. Jobs supported by the parks represent a large share of the working population in these regions at 6% and 36%, respectively. Also, as the methodology focuses on visitor spending, and the parks themselves charge very few fees in Iceland, public sector jobs generated by the parks are largely excluded from the results.

The total economic impacts of the three parks varied between $30–99 MM and 347–1140 jobs were generated. Sales, income and value-added taxes were $15–46 MM. These results are in line with previous case studies, demonstrating that the economic impacts were relatively well estimated using the conservative defaults applied by the MGM2 model, but employment impacts were previously overestimated, even when the most conservative defaults were utilized in comparison to local data from the Icelandic Labour Survey. This emphasizes the importance of localizing all applicable data in such economic analysis. Overall, the results confirm the economic importance of nature-based tourism in Iceland, and we find added value in studying both local and national-level economic impacts, even though it adds complexity to data collection.

More importantly, this study confirms that the MGM2 methodology can be localized to the Icelandic context, and if needed, to other locations in Iceland as the regionalization data is provided on the municipal level. We believe this study also supports similar exercises in other small states or regions. Even though we have used three NPs as a case study, the methodology is suitable for other national parks as well, and can guide policy- and decisionmakers and municipalities regarding the further development of PA estates.

4.1. Wider applicability of the study

The MGM2 method is well-described in the literature and provides a good starting point for adapted economic analyses in varying contexts, as shown by methodological descriptions and results from Brazil, Finland and Sweden (Huhtala et al., 2010; Kronenberg and Fredman, 2022; Souza et al., 2018). Finding suitable datasets locally can be challenging, but our study provides an example of how this can be addressed. This is an encouraging finding for other researchers and practitioners planning to adapt economic impact analysis methods to new PAs and provides a reference for discovering useful datasets. In summary, we used regional employment data for the I–O table regionalization (Statistics Iceland, 2022b; 2022c), a publicly available MATLAB script (Stair, 2013) to aggregate the sectors between the employment data and OECD Icelandic I–O table (OECD, 2021), business turnover data (Statistics Iceland, 2022d) together with average earnings (Statistics Iceland, 2022a) and Icelandic employment data to calculate the employment multipliers, and various information from tax authority and other sources for the tax and capture rates (see Appendix A). As described, we used existing visitor number data and collected visitor spending by onsite surveys. Finally, we developed our own Excel-spreadsheet to calculate the results, as the sectoral classification of the original MGM2 application did not match our data.

To our knowledge, this study presents the first time that LQ-methods have been used in Iceland to regionalize I–O tables, and thus we have no direct references or comparisons for the local economic multipliers. However, our results align conservatively with comparable studies, as discussed above. We used the FLQ-method to generate the regional economic multipliers as it was the most used and tested in literature.

However, calculating the AFLQ-multipliers for reference raised an interesting observation with hospitality and agriculture in one region, and indicates that the method might be worth considering for special case studies in highly specialized municipalities or regions.

There is limited literature on multi-destination and -purpose trips in the context of economic impact analysis of PAs, and we believe our approach provides a good future reference for other countries, which has been tested on a large visitor spending dataset. However, other researchers need to consider how well the travel patterns and visitor behavior in Iceland matches with other contexts in this respect. Similarly, we believe that calculating economic impacts on both local and national levels provides added value, at least in the context of Iceland. This needs to be evaluated as well in contexts as it is also dependent on travel patterns and visitor behavior.

4.2. Limitations and further research

Due to space constraints, we have focused on developing the localized economic impact analysis methodology in this paper. As initially outlined in Fig. 2, there are many questions that require further analysis; opportunity costs of the PAs in comparison with the economic impacts, influence of site-based factors, and comparing economic impacts to the investments made into the PAs. Nature-based tourism and nature protection may also entail adverse effects on the local communities and environment (Bruyere et al., 2008; Fortin and Gagnon, 1999; Hjerpe and Kim, 2007; Vedeld et al., 2016). A comprehensive sustainability analysis of the PAs and PA tourism is also necessary given many recent concerns regarding over-tourism in Iceland, e.g. (Alþingi, 2018, pp.3-5; Hallgrímsson et al., 2019; Sæþórsdóttir et al., 2020; Saviolidis et al., 2021). While nature-based tourism has provided significant economic benefits, its rapid growth may become self-destructive and presents the main management challenge for Icelandic PAs (Siltanen et al., 2022; Sorrell and Plante, 2021). Future research is needed to analyze the economic impacts within a sustainability framework.

We also note the following limitations regarding the economic impact analysis. Methods based on visitor data and travel costs only capture part of the non-market values. Many sites, especially UNESCO WHSs like þNP and VNP, are associated with significant existence (non-use) values that are difficult to estimate monetarily. Regarding the visitor data, an update is needed soon for SNP spending data as it was last collected in 2017 – a 5-year maximum interval has been suggested (Kajala et al., 2007, p.39). The visitor spending surveys from þNP and VNP's southern region should ideally also include a winter sample; both are open and popular all year, and tour activities continue uninterrupted. In þingvellir, tours in winter and summer are essentially the same; in VNP's southern region, winter is the high season for ice cave tourism. However, we do not expect this to influence daily spending significantly, as visitors mostly switch from one tour to another, and the short daylight period in winter does not generally allow multiple tours in one day. Finally, as a general observation, convenience sampling may induce biases into the sample (e.g. language skills may limit participation as surveys were offered in English and Icelandic only), and probability sampling was not possible due to time and cost concerns.

Regarding further economic impact analyses and the I–O data regionalization, finer NACE v.2/ISIC v.4 categorization in the Icelandic Labour Survey would make I–O table aggregation unnecessary and help to avoid potential resulting aggregation bias. According to (Miller and Blair, 2022, pp. 161–162), aggregation of input-output matrices is often necessary on a regional level due to the lack of detailed economic data, but may introduce sectoral aggregation bias if sectors or subsectors of varying structures are combined. Since the Labour Force Survey is currently only available with this classification, some uncertainty regarding the aggregated I–O table needs to be accepted. This issue should be followed on in future studies and iterations of the Labour Force Survey in case further granularization of employment data is provided. Also, we hope in the future that the average employee earnings by sector and company turnover figures are published by each region or municipality, allowing us to calculate regional employment multipliers. Finally, if future revisions of the Icelandic national I–O table include the household income separated from the business value-added, we will be able to calculate Type II multipliers and induced effects in the economic analysis. Currently we are limited to Type I indirect effects.

Credit author statement

Conceptualization, J.G.P. and J.S.; data curation, J.S., funding acquisition, J.S. and J.G.P.; methodology, J.S. and J.G.P.; formal analysis, J.S.; investigation, J.S.; writing—original draft preparation, J.S.; writing—review and editing, J.S., J.G.P., D.C. and B.D.; supervision, J.G.P. All authors have read and agreed to the published version of the manuscript.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jenvman.2023.118085.

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Table 1. Capture rates and tax rates used in the analysis.

Category	Capture rate	Tax rate	Source / rationale
Accommodation	80 %	11 %	Capture rate is based on a 20% booking fee used by major internet booking engines. Not all bookings are subject to these fees, but accommodation services also procure some equipment and services from abroad. Standard lower VAT rate (Icelandic Tax Authority, 2023).
Camping fees	100 %	11 %	Campsites are assumed to capture 100% locally as they are generally not part of international booking systems and utilize local supplies and construction services. Standard lower VAT rate (Icelandic Tax Authority, 2023).
Restaurants & bars & foodstuffs	75 %	11 %	Iceland has a 60% self-sufficiency ratio for food products in kilos (Nordregio, 2022), and adding labor costs in production, sales and services we achieve a conservative capture rate of 75%. Standard lower VAT rate (Icelandic Tax Authority, 2023).
Transportation, tours, recreational and cultural activities	50 %	11 %	Transportation category covers both buses and rental cars. Transport and tourism sector in Iceland is based on using imported goods: e.g. cars, fuel and outdoor/sports equipment. Additionally, internet booking engines and international tour agencies add booking fees up to 20%, hence a relatively low capture rate of 50% comprised mainly of salaries, local facilities and administration. Standard lower VAT rate (Icelandic Tax Authority, 2023).
Retail sales	20 %	24 %	Capture rate of retail sales is based on regional sectoral tax data retrieved from Icelandic Tax Authority (Siltanen, 2018). It conservatively assumes that all retail goods are produced abroad, and only employee salaries and taxable net revenue are captured in the local economy. Standard VAT rate (Icelandic Tax Authority, 2023).
Petrol stations	63 %	47 %	For tax collection purposes, all petrol station purchases are assumed to be petrol or diesel; assumption was supported by visitor spending survey questionnaires. 37% of the price petrol in Iceland is import cost and 47% are comprised of various taxes (Júlíusson, 2022).

Harmonization and cleaning of data

Expenses

- All expenses were converted to ISK using the Icelandic Central Bank midrate at the time of the data collection.

- If respondents copied locally paid expenses to paid elsewhere in the form, these were removed to prevent expenses being counted twice.

- If respondents provided the cost of one night's accommodation both for local and elsewhere location (their logic being to include the night before and current night), the local was kept and elsewhere was removed, regardless of which one was higher or lower.

- Package tours: For the 2017-18 survey data, the total day cost of the tour package excluding flights was placed in the 'paid elsewhere' -column to account for accommodation, transport, guide and food services in Iceland, but no attempt was made to break it down into the different services. In these cases, the costs of accommodation and transportation of these participants was excluded from the spending averages used in the analysis. This generates some bias towards the total impacts and makes the local impacts more conservative, as at least part of the accommodation and food services likely took place in the local surroundings of the sites. In the 2022 survey data, tour packages were broken down into accommodation, transport expenses and tours based on rack rates, as the survey collector asked and noted the hotel, type of rental car and any tours included in the package for the day.

- Any tours or recreational activities that respondents participated elsewhere in the last 24 hours were removed from the data before analysis as they generally are not related to the economic impact of the PA in question.

- If there was reason to suspect that respondents had forgotten or didn't know to provide a value for cost of accommodation or transportation, these figures were excluded from spending averages used in the analysis. For example, respondent selecting 'hotel' for type of accommodation but not providing any cost for the night of accommodation. In these cases, the rest of the spending data was still used in the analysis.

- A variable called 'Days adjusted' was created to make the time spent at the sites more conservative. Respondents were asked how long they spent around the vicinity of each site, accompanied by a reference map with a rough 50 km radius. If they answered more than two days, all replies were maxed at 2, considering that they were likely to also be visiting other sites in the area. The only exception to these adjustments were school or research groups that we knew based on the survey interview spend a longer time at the site. As the paper version of the form asked the time spent in the PA in days, many respondents put 1 for half-day / day-trips. On the electronic forms, "Half-day/daytrip" was a separate option from "1 (full) day", and entered as 0.5 days in the data. As all Snæfellsjökull data was collected on paper in the pilot study, to align the data conservatively between the studies, all '1 day' responses were converted to half-day/daytrips as 0.5 in the analysis. The same treatment was given to Þingvellir data from 2018 to remove time spent on daytrips at Gulfoss and Geysir to be counted in as time spent in Þingvellir, as they were visible in the vicinity map but are in fact other PAs.

- Obvious mistakes in the spending figures were screened and corrected. E.g., if a respondent had said they used "100,000" ISK for accommodation per person per night when they most likely meant 10,000 ISK. Similarly, if they had chosen one currency but used another, this was corrected.

- Average spending figures used in the analysis include zeroes and exclude spending if the visit to the site was non-planned. If the visit was one stop among many during the day, the spending was divided by the total number of visits in the 24h period, using only a fraction of the spending for the PA in question.

- In the analysis, the number of visitors was multiplied by the average stay based on the survey to establish the number of visitor nights at the site, see Table 2.

Table 2. Average length of stay at different sites (days).

	Snæfellsjökull	**Vatnajökull (South)**	**Þingvellir**	***Overall***
Adjusted weighted average	1.4	1.0	0.9	*1.1*

Detailed information regarding visitor segmentation

Visitor segments (Table 3) were created based on following logic:

- If a visitor answered *Yes* to being a local resident in the surrounding municipalities - he/she became a local resident and their spending was excluded from the results.

- If a visitor answered *No* to being a local resident in the surrounding municipalities, but Iceland to the country of residence - he/she became a domestic visitor.

- If a visitor was neither of the above and answered being on a daytrip - he/she became a day visitor.

- If a visitor was none of the above and answered to be camping (including campervans) or sleeping in the car - he/she became a camping visitor.

- If a visitor was none of the above - he/she became a hotel visitor (including all other types of indoor accommodation).

Table 3. Sample sizes by visitor segments at the research sites, only valid surveys included.

	Snæfellsjökull		**Vatnajökull**				**Þingvellir**		***Total***	
			Jökulsárlón area		**Skaftafell**					
DAY	203	41%	235	42%	209	47%	422	73%	*1069*	*51%*
HOTEL	228	45%	244	44%	170	38%	116	20%	*758*	*36%*
CAMP	50	10%	57	10%	55	12%	40	7%	*202*	*10%*
DOMESTIC	20	4%	24	4%	8	2%	0	0%	*52*	*2%*
LOCAL RES.	0	0%	0	0%	2	<1%	3	<1%	*5*	*<1%*
Total	*501*	*100%*	*561*	*100%*	*444*	*100%*	*581*	*100%*	*2087*	*100%*

Table 4. Average total 'PA-only' spending per visitor per day for each segment in ISK (weighted by N).

Segment	Fuel and gas stations	Transportation	Tours and rec.	Cultural activities	Accommodation	Cafes and restaurants	Groceries	Souvenirs	Other retail	*Total*
Domestic visitors, N=52, 2.5%	851	626	205	63	698	882	751	157	0	*4233*
(USD)	6	4	1	0	5	6	5	1	0	*30*
Day-trip visitors (foreign), N=1070, 51.4%	850	2838	3370	134	3940	1655	667	189	174	*13817*
(USD)	6	20	24	1	28	12	5	1	1	*98*
Visitors in accommodation (foreign), N=758, 36.4%	1172	3064	5295	103	7130	2329	603	191	443	*20331*
(USD)	8	22	37	1	50	16	4	1	3	*144*
Campers (foreign), N=202, 9.7%	1255	4410	2739	22	3076	1300	1005	234	291	*14332*
(USD)	9	31	19	0	22	9	7	2	2	*101*
Overall, N=2082, 100%	1006	3018	3931	110	4937	1847	678	194	279	*16000*
(USD)	7	21	28	1	35	13	5	1	2	*113*

Winter versus summer data

- The study at Snæfellsjökull NP (Siltanen, 2017) showed that visitors in the winter spent on average 26% more money per day in total than in the summer (26.364 ISK versus 20.962 ISK) due to mainly two reasons: lack of camper segment in the winter that spends the least amount of money per day of all the foreign visitor segments, and visitors participating more in guided bus tours instead of self-driving. Thus, by using summer spending data to cover the entire year, we likely underestimate the overall spending as the visitor segment that is spending the least (campers) is much smaller in the winter. During the winter, visitors spent 25% less time at the national park (on average 1.2 days compared to 1.5 during the summer).

Survey design

Examples of used paper and electronic survey forms are published in (Siltanen, 2018).

List of surrounding municipalities

Municipalities in the vicinity of each NP, which were included in the regionalization of the I-O tables.

Vatnajökull National Park (South region)

Sveitarfélagið Hornafjörður
Skaftárhreppur

Þingvellir National Park

All Capital Region municipalities
Sveitarfélagið Árborg
Hrunamannahreppur
Hveragerðisbær
Grímsnes- og Grafningshreppur
Bláskógabyggð

Snæfellsjökul National Parkl

Grundarfjarðarbær
Helgafellssveit
Stykkishólmsbær
Eyja- og Miklaholtshreppur
Snæfellsbær

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Paper III

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Developing Economic Policy Instruments for Tourism Management in Protected Areas

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Abstract
Protected areas (PAs) are the main strategy for area-based nature conservation, and they provide opportunities for rural development through tourism and recreation. Economic policy instruments help PAs to manage commercial activities by regulating visitor flows and providing revenues to strengthen infrastructure and oversight. We employ Icelandic National Parks as a case study of the challenges, opportunities and constraints associated with introducing a concession system to regulate commercial tourism. We summarize and review how the legal framework is used and conduct 21 semi-structured interviews to elicit PA manager and business stakeholder views regarding concessions. Our study answers the literature calling for more studies on concessions and is novel in the context of the Nordic rights to roam. Our results show Iceland has introduced a comprehensive, legally-binding framework for concessions. Stakeholders generally agree that commercial activities need to be regulated, and concession revenues are an important source of financing for the PAs. However, concessions have been introduced primarily with economic motives, and the main challenge is to integrate holistic sustainability into concession contracts with social and environmental criteria. Overlaps and conflicts in the legal regulatory framework contribute to this challenge and could be initially addressed by clear policies providing guidance and interpretation.

Keywords Protected area management · National parks · Policy instruments · Concessions · Tourism · Sustainability · Rural development

Introduction

Protected areas (PAs) are the main strategy for area-based biodiversity conservation and set to cover 30% of the world's terrestrial and marine environments by 2030 (CBD 2022). Area-based conservation in the form of formally establishing PAs comes with reorganization of rights and responsibilities on access and land use activities within its boundary, guided by the policy objectives of the respective area (Watson et al. 2014). This usually manifests in a system of governance for the respective PA that allows for the design and application of multiple policy instruments to meet its policy, regulatory and management goals, e.g. (Vatn 2015). Policy instruments for PA governance follow a widely applied typology of economic, regulatory, and information-based policy instruments and their multiple mixes (Barton et al. 2017; Fischer et al. 2023). As the most important management priority of PA is conservation of nature and its processes, land use economical activities that may endanger conservation goals are generally restricted within their boundaries.

Recreation and tourism are predominant economic activities within PAs and promoted by multiple international actors as important drivers for both conservation and rural community development (Spenceley et al. 2017; Stolton et al. 2021; World Bank 2021; Thompson et al. 2014). This has land use policy implications as PAs sometimes compete with extractive land use options (Montesino Pouzols et al. 2014; Rodríguez-Rodríguez and Sinoga 2022). Tourism in PAs can generate significant revenues, add to their conservation efforts but can also result in negative impacts, such as conflicts with locals, degradation, erosion, loss of biodiversity and pollution (Belsoy et al. 2012; Purnomo et al. 2022; Živojinović et al. 2024). Thus, seeking sustainable tourism management becomes a key policy priority for PAs, and wide

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stakeholder inclusion in decision-making leads to better conservation outcomes, e.g. (Nyaupane et al. 2020; Matiku et al. 2021). Effective policy instruments can support the PA primary goal of nature conservation by financing management and infrastructure development. In addition to conservation goals, the socio-economic impacts of PAs are getting increased attention, and growing emphasis is placed on the employment impacts generated by the PA and their capacity to generate self-sustaining revenue (Font et al. 2004; Øian et al. 2018; Stolton et al. 2021; Snyman and Bricker 2019).

Fees and concessions are policy instruments that have been introduced to PAs to regulate access and generate income (Eagles, 2009; Font et al. 2004). Entrance fees to PAs are widely applied globally and free access is becoming rare, with the Nordic countries being an exception (Van Zyl et al. 2019). Concessions are defined as 'the right to use land or other property for a specified purpose, granted by a government, company or other controlling body' (Spenceley et al. 2017: 9). Concessions are used to outsource services to private companies, communities, NGOs and joint ventures instead of operation by the PA authority (Spenceley et al. 2019; 2017; Thompson et al. 2014).

Despite the increasing interest and practical application, scientific studies on these economic instruments in the PA context are still few and the topic has been raised as a research priority in park management (Dinica 2017; Eagles 2014; Lambin et al. 2014; Wyman et al. 2011; Dinica, 2018). There is a lack of empirical evidence on how various instruments work together (Lambin et al. 2014; Ring and Barton, 2015), and a lack of policy guidance for implementation (Rode et al. 2016). Furthermore, there is a lack of understanding of how stakeholders perceive different economic policy instruments (Fischer et al. 2023).

Concessions and fees in PA management are relatively recent in the Nordic countries due to wide public access rights on land and state-run park management authorities (Øian et al. 2018). Legislation for the Nordic PAs has been oriented towards fair service provision, indicating that fees must not exceed the cost of providing the services (Øian et al. 2018). Finally, there is a debate whether PA commercial activities fall under the Nordic public access rights (Øian et al. 2018; Tuulentie and Rantala, 2013; Sandell and Fredman, 2010; Bogason et al. 2021). As a result, a solid legal framework for concessions has been lacking and only recent legislative changes have enabled progress on this topic, highlighting the need for further studies in the Nordic context, including Iceland.

This study analyzes the recent development of economic instruments in the three Icelandic National Parks (NPs): Þingvellir, Snæfellsjökull, and Vatnajökull. In Iceland, legal foundations for concessions in PA have appeared incrementally since 2007, but few have been issued so far (Petursson and Kristofersson, 2021; Siltanen et al. 2022). Securing conservation goals amid high visitor numbers and enabling socio-economic gains from PA tourism are the main challenges for PA authorities in Iceland (Siltanen et al. 2022, 2023). In this context, concessions are an important policy instrument, and their recent introduction to the Icelandic PA instrument portfolio can provide lessons for other countries introducing concessions to PA management.

The overall objective of this study is to address the research gap on the challenges and opportunities of introducing concessions in PAs. Our study takes Iceland as a case, situated in the Nordic context where concessions have not historically been applied, to answer the following research questions (RQs):

1. What challenges are associated with the management of commercial activities using concessions in protected areas?
2. What are the opportunities and constraints of application of concessions in PAs?
3. What policy implications can be drawn from the study to address the challenges in implementing concessions in the PAs?

Methods

Governing PAs as Environmental Goods

The aim of public policy is generally to improve delivery of public goods through implementation of policy instruments (Blackstock et al. 2021). PAs are managed as common (state) or private property resources with the objective of serving society, but the needs of conservation and economic development can be difficult to balance (Child 2004; Bromley 1990). Various environmental governance systems are set up to manage PAs and steer development, implement policies and manage adverse effects codified in laws and regulations (Vatn 2015).

Conceptual Framework

Policy instruments are broadly classified as economic, regulatory and informational instruments, and often employed as mixes towards a common goal (Barton et al. 2017; Fischer et al. 2023; Lambin et al. 2014; Ring and Barton 2015; Randle and Hoye 2016). A recent literature review concerning economic instruments that govern land use focused on taxes, charges and subsidies, reflecting the traditional sources of PA funding such as government fees, charges and grants (Ackerschott et al. 2023).

Economic instruments are becoming increasingly common and recommended in natural resource management; however, focus on their application in PAs has been limited, e.g. (Ring and Barton 2015; Rode et al. 2016). PAs have applied many instruments for regulating visitation and sourcing tourism income, such as entrance fees, user fees for specific activities and services, concession fees and leases, direct operation of commercial services, taxes, volunteer work and donations (Font et al. 2004). An important question for the PA authorities is how the fees are managed and distributed after collection. For example, fees can be retained for the specific activity from which they were raised, retained in the PA, distributed to other PAs, or paid into general revenue of the government (Font et al. 2004).

Concessions are economic instruments, which influence social or economic action through the exchange of "economic values" (Krott 2005, p. 191). A concession, in the strict definition, is typically a long-term right to use land or property for a specified purpose. Lease or management contracts describe agreements where the PA rents land or facility to a commercial operator for a fixed period. Licenses are issued and audited against specific conditions by the PA, allowing businesses to operate tours requiring specific experience, expertise or equipment. Permits are defined as temporary permissions for lawful activities and have a shorter time span. Many models can be used for concession pricing from open bidding to fixed, revenue- or unit-based fees. (Spenceley et al. 2017).

Beyond the scope of economic instruments analyzed in this study are taxes levied on goods, services and transactions, whether these are national or locally-levied (Font et al. 2004). Generally, taxes are collected to the treasury and distributed by the government. In some legislations, it is possible to introduce conservation, environmental or tourism taxes that may be earmarked for the PA estate (Font et al. 2004; Zabala et al. 2022; Øian et al. 2018). Tax-based income can provide core funding for PAs and shield them from external shocks like the COVID-19 pandemic (Leung et al. 2018; Smith et al. 2021; Spenceley et al. 2021; Bhammar et al. 2021).

Finally, donation schemes and volunteering are important economic instruments supporting PAs in some regions (Font et al. 2004). New economic instruments such as payments for ecosystem services (PES), environmental mortgages and carbon payments have also been proposed (Rode et al. 2016; Whitelaw et al. 2014). Overall, a wide range of economic instruments is available for PA management and a holistic evaluation is necessary in each application context (Kärkkäinen et al. 2020).

The Case Study

Iceland is sparsely populated with a sub-400,000 population on an area of 103.000 km^2. It saw a dramatic rise in tourism prior to the COVID-19 pandemic with visitor numbers increasing from ca. 500,000 to over 2 million between 2010 and 2019; most visitors (89.2%) citing nature as the reason for visit (Ferðamálastofa 2021, 2022). Various impacts of mass tourism have materialized: positive economic and social impacts, improved PA infrastructure, but also negative impacts such as littering, trampling, off-road driving, overcrowding, conflicts between locals and tourists, rising inflation, housing-shortage and increasing carbon emissions and waste products, (Siltanen et al. 2023; Helgadóttir et al. 2019; Environmental Agency of Iceland 2024; Wood-Hill 2019; Jóhannsdóttir et al. 2019; Sorrell and Plante 2021; Sæþórsdóttir and Hall 2021).

Tourism is the main management challenge for PAs in Iceland (Siltanen et al. 2022), and the NPs are particularly relevant for concession research as they attract high visitor numbers, host most varied tourism operations and employ the widest variety of economic instruments. Our study takes the case of all Icelandic NPs: Þingvellir (ÞNP), Snæfellsjökull (SNP) and Vatnajökull (VNP). In VNP, our analysis focuses on the Southern Region, where all the economic instruments have been introduced. Figure 1 provides a map of the park locations and sizes, see Online Resource 1 for more details.

Data Collection and Analysis

Data collection was carried out in two phases. First, we studied the legal framework for concessions and compiled an overview of all the concession-regulated business activities based on the information about the concessions on the PA websites during 6-8/2023. Where this information was not available, email enquiries were sent to the corresponding park directors and managers to complete the overview. Second, an interview request was sent to the economic and regulatory stakeholders directly connected to the concession arrangements. This included all businesses identified in the first phase, as well as park staff responsible for managing the regulated business activities.

We limited the scope of stakeholders to those directly involved with concessions, i.e. the park staff in concession management and the businesses currently regulated by concession arrangements. For a complete representation of all stakeholders' views, a full stakeholder analysis should be carried out. The scope of our study focuses on commercial activities on state land, as all the study sites and most PAs in Iceland are in state ownership. Privately protected areas would undoubtedly have different questions regarding

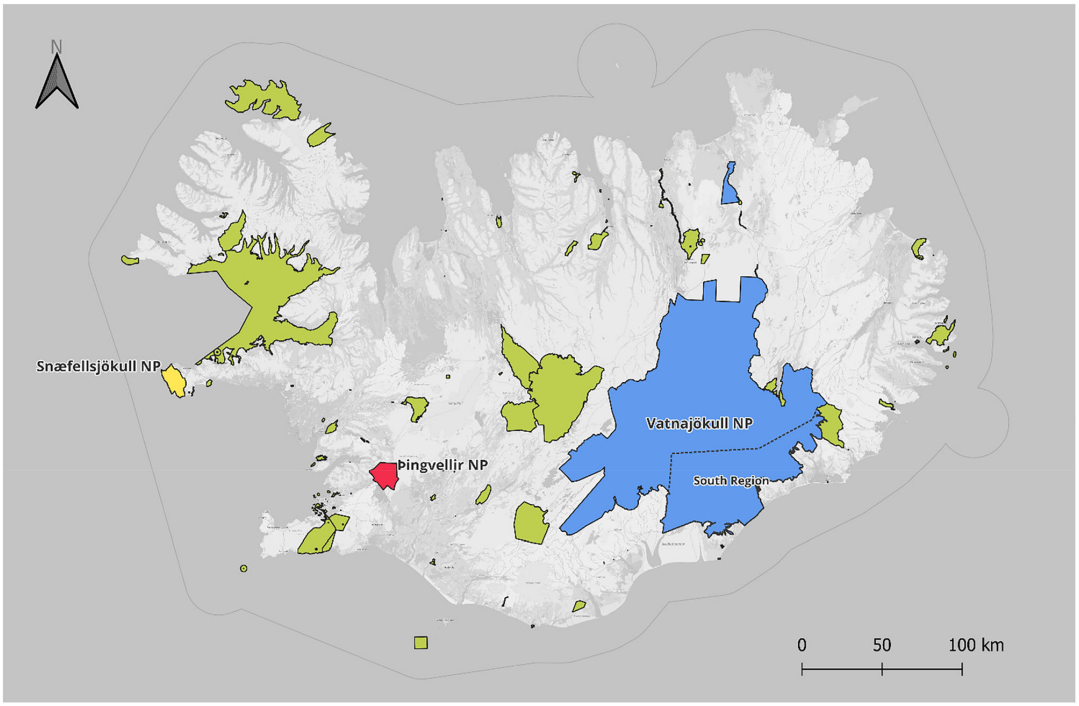


Fig. 1 Map of Iceland's terrestrial PAs and the study sites

regulative economic instruments. Similarly, as the focus is on regulation of commercial activities, we did not analyze stakeholder views on end-user fees such as parking or service fees.

We used initially our own contacts with the PAs and allowed the park managers to suggest additional people to contact, thus using a combination of purposive and snowball sampling (Oribhabor and Anyanwu 2019). Overall, the response rate for the interview requests was 40.4%. We interviewed the directors, area managers or head wardens and companies operating regulated business activities at each site, 21 people in total (see Online Resource 2; Tables S2.1 and S2.2). Most companies represented in the sample were relatively small local businesses providing guided tours with less than 20 employees. Three companies were mid-size (20-50 employees). Larger companies did not take part in the study thus the results reflect the views of the SMEs, a limitation of this study.

Interviews were carried out using a semi-structured and open-ended question guide (see Online Resource 3), both to obtain responses consistent with the concession framework and RQs used in the study, allowing new views to emerge (Adams 2015). Informed consent was obtained from all participants before the study. Interviews were held in English, recorded and transcribed in Microsoft Teams. Transcriptions were then manually reviewed and corrected for any errors.

Transcribed data was coded using top-down elaborative coding (Auerbach and Silverstein 2003). All transcripts were analyzed at least three times. During the first round, text relevant to RQs and concession instruments was highlighted. On the second round, passages of text were grouped into themes derived from the RQs and the concessions categories: (1) challenges for management, (2) permits and licenses, (3) management leases and concessions, (4) opportunities, (5) constraints, and (6) emerging ideas and concepts. On the third round, the focus was on grouping emerging topics together and linking them to the instruments and management challenges. Highlighting and thematization was carried out using colored highlighters on transcript-printouts, which were then used to generate thematic summary tables in Excel. If a topic was mentioned by more than five stakeholders, it was included in the thematic analysis.

The following concession-related themes emerged from the thematization (%-interviews mentioned): source for funding (76%), supporting local communities (67%), better customer experiences (57%), fee mechanisms (43%) and

Table 1 Summary of stakeholder support and challenges regarding concessions (P=Park/B=Business)

Support	Challenges
• Provides a legal framework for activities. (P)	• Can stifle innovation if new activities don't fit in the frame of the instruments. (B)
• Essential tools for regulating commercial activities to ensure nature conservation. (P&B)	• Lack of workforce to manage and enforce the concession system. (P)
• Enforce safety regulation and necessary guide training. (P&B)	• Lack of punitive power for violations. (P&B)
• Provides better visitor experience. (P&B)	• Contracts issued often too short for companies, lack of foresight and predictability. (B)
• Necessary to control the visitor numbers and group sizes particularly for activities constrained by space or availability. (P&B)	• Difficulties in implementing social and environmental goals through concessions, monetary focus in the overarching law. (P&B)

fairness considerations (29%). Due to the relatively small sample size, the data was not used for further quantitative analysis beyond shares of stakeholders expressing a particular view. The interview data was used to answer the RQs and to provide a deeper understanding.

Results and Discussion

The development of the legal framework for concessions gives an interesting insight to the needs and changing priorities in PA in Iceland. All the NPs in the study were established without legal tools for concessions under separate legal frameworks. Introducing three distinct legal frameworks for the same purpose is a major effort, and each agency having to implement their own legal framework has added administrative workload in comparison to a single system. Despite these complexities, the current legal framework has evolved to a point where it gives the PAs a clear mandate and necessary tools to manage commercial activities in parks. Overlaps between the site-specific and general legislation may cause difficulties in the implementation, and the commercial use act (CUA) stating that the revenues from each concession contract need to be negotiated between the Ministry of Finance and the PA authority is a challenge for the PAs. See Online Resource 1 for details of the legal framework and current concession system.

Despite being at a nascent stage, the concession system in Iceland is quite diverse, utilizing concessions at all levels and various fee systems. The current concession system focuses on regulation of specific activities and services. The main single commercial activity across the NPs is various sightseeing tours, which are not yet regulated by concessions, though the CUA and the park-specific acts state that all commercial activities should be. Thus, the PAs have further work ahead in expanding the scope of the agreements.

Stakeholder Support for Commercial Tourism Management

Incremental updates to the legal framework and utilization of various economic instruments reflect a growing need for legal means of tourism management. A consensus emerged from the interviews with PA authorities and businesses stakeholders, that commercial activities in the NPs should be regulated through various concessions. Answers commonly referred to ensuring environmental protection, legal responsibility, and customer experience and safety (Table 1).

One business owner expressed clearly why concessions are necessary for nature conservation:

This is basically a natural reserve, it's something that Icelanders as a nation agree on, to make these boundaries of the land as a NP, and it's very important when you make that decision, that you preserve it, and to be able to preserve it, you have to be able to control it and adjust the traffic on it, […] and you have to do that through contracts with those stakeholders that use the park, either it's a guest or a tour operator. You have to have control of it, so you don't you don't destroy the fundamental importance of establishing the natural park. (B2)

However, one business owner raised criticism towards the need for operating licenses:

If the NP would work like we expected it to work, then [regulation] would be necessary, but it is not working now. The NP is kind of holding back. […] You have to ask for a license for everything that you want to do. And if people have new ideas, they are always the threshold. The first that the NP says is "no" instead of supporting a new types of activity…. (B3)

Concerning examples were raised regarding tours on Breiðamerkurjökull glacier and Breiðamerkursandur outwash plain before it became part of VNP:

At that time, people were putting so many guests into the ice caves that at one point there was no oxygen in the ice cave and people started fainting… there were no rules and people were driving all the way on the glacier to the opening of the ice cave and just letting people out into the ice cave and then back into the car and get out. (P1)

Companies were boycotting the safety regulations before, not putting their guides on right courses and taking people on glaciers without having experience […], so this [regulation] is definitely in the right direction. (B5)

From the business perspective, regulation was considered most important for limited resources, where there are physical boundaries in terms of how many people can participate in an activity:

I think in the beginning we were thinking this is not really needed, but we have seen how the bigger companies are operating and there's definitely a need to regulate this and we think the NP should try to enforce this better. […] I think they should definitely limit the numbers that the companies can bring. (B4)

Businesses pointed out that good customer experience is critical for them, and they have solved problems of congestion and related bad customer experiences by developing the products and finding new locations, but they have had challenges in coordinating these with the PAs.

Challenges in Concession Management

The interviewees confirmed the nascent stage of the concession system implementation despite the diversity of instruments in use, and many issues particularly regarding full-scale concessions and licenses were noted both by park authorities and companies, see Table 1 for summary. Park authorities, particularly in VNP, commented on the lack of workforce for processing licenses and overseeing regulated activities. Legislation is also lacking in power to act on violations.

The weakness [of the concession system] is just lack of manpower and funding to actually oversee it. […] I also find that our laws or like the legislation system, is a bit weak. […] We can say no, you can't have a contract, but our legislation system is built in a way that doesn't hold any power. (P4)

If [the rangers] come across a company that don't have a permit, the only thing they can do is… call the police and have them there and then we can take it to our lawyers. (P2)

VNP is a co-managed park with four regional boards and a central board including a wide range of stakeholders in its final decisions, and decisions regarding limiting or controlling business activities have proven difficult for the board, causing delays in implementation.

We have the laws and regulations of the NP, which state that […] you're not allowed to work within the park unless you have a permit. But then it was kind of very difficult for the board of the NP to decide, or to continue with that […] they should organize the activities and [see] if it's limited or not, and if you're limited, you have to advertise it. If it's not limited, you can get a permit. (P2)

Concessions can be a source of 'overwhelming issues' for co-managed PAs where the beneficiaries, such as municipalities and tourism businesses, sit on the board with the PA representatives (Petursson and Kristofersson 2021). Companies in the VNP South region also criticized why after four years of the contract requirement introduced by

regulation 300/2020 (Government of Iceland 2020), they are still the only ones affected:

> *This is the only area within the NP where companies have to pay to get licensed to be able to operate within the NP and not even all companies. […] The people in other parts of the NP should pay their share to be able to keep up the infrastructure and maintenance needed. (B1)*

Ice cave tours and glacier hikes were the highest priority for VNP to be regulated due to safety concerns. However, both tours take place in dynamic natural settings, and though the PA has recognized the need for further regulation and setting limits on visitor numbers, it's challenging due to the changing natural conditions:

> *It is difficult because the ice caves change sometimes between days, […] so the rules are constantly changing. So it's very difficult to say that a 10m^2 can have 10 people per hour per day… But there are some guidelines, but they are just super difficult to implement because things change so fast. And sometimes the glaciers flood on the west side, and then everybody […] comes to the east side because everybody has booked the trip, and you have to provide them a trip because otherwise you have to give them a refund. And it's a lot of money. (P1)*

Most businesses in VNP lamented that the one-year licenses were too short for meaningful business planning in terms of growth, investments and hiring staff:

> *The licenses that they are handing out now… They are only for one year at a time and no one is building up a company for one year at a time. (B3)*

> *There are housing issues, and we have to build houses for our staff, and you just don't do that for just 2-3 years. […] So for us, I would want to see at least around 15 years or something because, we have to build some new houses… There has better oversight of it, but if it's a very short time, like 2-3-5 years, like it's too little for the investment we have to do… (B5)*

Short term licenses were mainly discussed by companies in the VNP South region, where they have been part of PA's interim efforts in learning-by-doing and trying to find a working system in changing conditions according to park managers; however, a consensus emerged from businesses across all NPs that licenses and permits for activities requiring little or limited infrastructure should be around 5 years, and larger business endeavors would require 10-20 year contracts.

The challenges described above can be characterized as practical, contractual and enforcement issues. Another major theme rising from the interviews was related to the social impact of the concessions. Support for PAs is often linked to the rural development and economic opportunities they provide, e.g. (Stolton et al. 2021; World Bank 2021). VNP is a particularly interesting case among the Icelandic NPs, as strengthening local livelihoods is a legally binding objective for the park and concessions are a key instrument for the implementation, guided by the PA's employment policy. The importance of this topic and related challenges were raised in 67% of the interviews; it was widely discussed in most interviews from VNP and all interviews from SNP, though SNP has no legal obligations regarding this theme.

> *They should factor in […] the community impact, like it is creating local jobs? Are they actually living there with their families? Because I think this matters. When I started here, people did not ask me about my job, they asked if I would bring a kid into the school. (P4)*

> *There's a lot of money here and it needs to stay in the communities and build infrastructure as well and build families and people that come here because this area can take so many more residents. But if we only keep them in container houses, they're not going to live here, they're only going to sleep here while they're working and then they're going to live somewhere else. (P1)*

However, this goal has proven difficult to address due to conflicting laws, e.g. regarding equal treatment of businesses in tender evaluations.

> *Administrative law states that we can't treat different companies unequally. So, every time that we would like… right, OK, this is a perfect opportunity for us to build something with the heimafyrirtæki [local companies], we're not allowed, because administrative law in Iceland states that you have to treat every company the same… But this kind of clashes with […] the 4th aim of the park, to reinforce and support employment and work in its immediate vicinities. (P4)*

Discussion regarding local businesses was most often brought up in connection with large-scale concessions, with interviewees from PAs and businesses concerned that local businesses would have no financial ability to compete in large tenders without some special criteria supporting them,

resulting in large companies from Reykjavik or even abroad winning them. Many interviewees saw this would result in the locals losing their businesses altogether.

> *Let's say a company that is not local gets to build up everything at Jökulsárlón… We know that the locals will be out. We are too small. We will never be… We will never have the amount of money that is needed to participate in that. (B3)*

> *One company just pays for the year and can distribute that… use everything for themselves or distribute it to other companies, […] which basically will kill all the smaller companies and the big companies will have all the profits. […] We us, the little guys, we have nothing to say in this and we have no control there and we can only basically just pay what we're told to pay. Nobody cares if it will kill us or not. Nobody cares. This is our problem. (B8)*

Social impacts are tied to the goals and allowances of the park legislation. Smaller companies, afraid of not being able to compete in tenders, often referred to the CUA, which uses price offer as a key evaluative criterion, though there can be other criteria as well. All the interviewed PA staff opposed having monetary offer as the main criterion.

> *Maybe the only drawback of the nýtingylög [CUA] was […] a higher emphasis on just the monetary capital… money value off the outcome, which I find both interesting and a little bit disappointing as well, because sometimes the monetary value is not the main issue, it's more the management restrictions that you would like to enforce with a limited option, for example tenders. (P9)*

> *With maximizing profits, always we could also be looking at losing knowledge. So people […] working for little local areas would be cast out and their knowledge would be lost to us, which is very important, local knowledge is very important for the park. (P7)*

> *You can see it [as] profit on this point, but there is loss somewhere else in the system, […] so this does not take the whole picture into account, I think. So, I would have seen this more balanced, these goals. […] OK, [the state] should get money out of their land, but the state also has other goals that just make it perfect. (P3)*

PA managers saw concession revenues connected to further issues beyond profit or social impacts, also environmental standards, climate change mitigation and visitor safety. Several businesses also had similar thoughts, suggesting customer safety and local expertise as the key qualitative criteria. It is evident that the goals of the CUA were not thoroughly discussed with the PAs or other stakeholders during the preparation of the CUA in the ministries.

Opportunities and Constraints of Concessions

Looking beyond the immediate needs and challenges of regulating business activities in the PAs, the interviewees, both in businesses and PAs, saw many opportunities in concessions. For example, 76% saw concessions as a way to develop the PA infrastructure and hire more rangers. This idea follows the park-specific laws but is potentially in conflict with the CUA, where concession revenues are collected by the Ministry of Finance and distributed at their discretion.

> *For example, the rekstrarleyfi [management lease] or sérleyfi [full-scale concession], I think there is a great opportunity there for building up the area because we need more infrastructure here and to be honest, I don't think that the government will pay for it. (P1)*

However, the PAs commended the CUA for providing a clear justification for regulating commercial activities and being able to use criteria to increase quality and steer activities towards environmentally friendlier and safer visitor experiences. Overall, improving the visitor experience was mentioned in 57% of the interviews. Businesses in particular saw concessions as opportunities for deeper cooperation with the PAs and new business opportunities; with the right tender criteria, the concessions could also support local businesses. The PAs also saw concessions as an opportunity to get a holistic picture of all commercial activities, proposing one system across all the PAs in Iceland to be established to manage the concession system, thus companies wouldn´t need to apply separately with different processes to each PA to operate:

> *I think that the sole reason for having a concession system is to try to have a holistic view of all the activities that take place on behalf of commercial operators. (P9)*

Whereas most interviewees agreed on the opportunities, views on the constraints of concessions were more varied. The most often-stated response from both business and PA interviewees was linked to large-scale concessions and the risk of large companies buying the small local businesses out of the market. PAs were also concerned about the lack of resources needed to manage an extensive concession

system, or getting lost in the complexity and making irrelevant demands to businesses. Lack of data on the business environment and support from the Ministry for the Environment were also raised as constraints.

Large-scale concessions operated by a single company were seen as being potentially problematic both from the PA and business perspectives, primarily in terms of difficulty in terminating these contracts due to contract breaches or poor performance due to lack of competition after concession is issued.

> *Our control over [the site] is very limited. We are lucky because they do it well in most cases, but […] if we are trying to make them do something differently, it's difficult for us, when you have a contract that is… […] The bigger the financial interest, the smaller the state is in trying to control something. (P3)*

To address this, PAs raised the idea of rather giving out several concessions or splitting larger concessions for activities that are limited by space or capacity. No single solution emerged for sharing a concession, but several ideas were suggested: using qualitative criteria such as safety record, environmental policies, and/or local experience, or quantitative criteria such as price-offer and market-shares that are reviewed every year based on other criteria to allow the companies meeting the criteria best to grow. Dividing concessions into smaller contracts also mitigates the risk of disagreements over resource valuation, end-of-contract transfer and capture of public resources by large-scale concessionaires, which can leave PAs in difficult situations (Purnomo et al. 2022; Zhang and Liu 2018; Dinica 2018; Roddewig 2021).

Finally, interviewees saw an opportunity in per person fees for concessions. During the interviews, the only per person fee for a regulated activity in the Icelandic NPs was a service charge for Silfra diving and snorkeling in ÞNP, which companies add onto their tour prices and individual visitors pay themselves. This was widely seen as a feasible and fair solution by the companies and PAs, scaling for different-sized companies and business up-and-downs as companies only pay for the customers they obtain, essentially a revenue-share mechanism:

> *It's a really fair thing for as many people that are coming in to […] use the NP, there's a certain fee paid so it's not a big risk for the company, and the NP also gets paid for the right use for as many people as are using the NP. (B9)*

The necessary workforce to verify the visitor numbers for such mechanism was seen as the main constraint, potentially addressed by basing the fees on vehicle size and automatic plate recognition, where applicable. A summary regarding the opportunities and constraints is provided in Online Resource 2: Table S2.3.

Sustainability and Other Cross-cutting Issues

As the PAs intend to use competitive tenders for limited resources to regulate the number of visitors and introduce environmental performance and social criteria in the tenders, the core question becomes how to introduce all aspects of sustainability in the concession system (Harðardóttir 2024). The greatest challenge is with large-scale concessions as the environmental, social and economic stakes are high. The CUA is focused on economic returns over social and environmental goals. A good example of the law's impact is a government-commissioned report evaluating options for the new Jökulsárlón concession with a solely economic analysis, based on perpetual growth in tourism (Government of Iceland 2024). The current legal framework allows PAs to set additional criteria beyond an economic offer, but it is not clear how much non-economic criteria can weigh in the decision-making process, and interviewees indicated a need for an employment policy to provide more guidance for the tender criteria.

Prevalence of economic rationale and challenges in social impacts linked to concessions are not only an Icelandic issue and have been recognized in various studies globally (Brumatti and Rozendo 2021; Purnomo et al. 2022; Bogason et al. 2021; Wyman et al. 2011). Encouraging examples can be found in literature, where concessionaires have led environmental policy and action in the PAs, motivated by personal values, contractual obligations and profit generation (Lackey and Bricker 2022; Estima et al. 2014). A government policy that provides guidance and interpretation between park-specific and national laws regarding concessions is necessary, and it's important address sustainability from beginning of the process (Munro et al. 2006). Best practice checklists for concession contracts could be adapted to the local context, e.g. (Wyman et al. 2011; Spenceley et al. 2017), as well as an Icelandic interpretation of the five-pillar sustainability framework provided to ensure all aspects are covered (Slocum 2017).

Challenges in decision-making, partially due to ambiguities in applying the legal framework, have resulted in various delays in implementation and perennial temporary procedures in the PAs. For example, the 1-year licenses and contracts issued by VNP have made long-term planning difficult for businesses. Similar delays were also experienced at the other study sites. ÞNP updated its legislation in 2019 (effective 6/2020), requiring all commercial activities to be contracted and further conditions to be established in an employment policy (Þingvellir National Park 2019). Overall, little progress was reported in the interviews

towards implementing the target of the CUA of having all commercial activities in the PAs assessed under a concession framework within five years of the law's entry into force. Park authorities raised concerns regarding the support from the ministries, and conflicts between the legislations from the Ministry of Finance and Ministry for the Environment.

Introducing new management tools and implementing legislative updates takes time, but several year delays raise questions whether the updates have been met with a matching increase in capacity. Interviews with PAs cited a lack of workforce and specialists, a common issue for PA management effectiveness, where legislative updates can be introduced effectively but implementation lags behind (Leverington et al. 2010). Internationally, PAs have hired staff for the sole purpose of concession management and come to realize that managing concessions is costly (Spenceley et al. 2019; Wyman et al. 2011). Regarding sourcing or combining such expertise and workforce, the merger of the SNP and VNP agencies could provide obvious synergies (Icelandic Parliament 2024).

Finally, if the PAs are expected to use concessions as a source of funding, it is urgent to resolve the ambiguity of the CUA and the park-specific laws regarding concession revenues and provide a clear government policy on how PAs benefit from the concessions without separate negotiations for each contract. If the concession revenues end up in the general treasury, there is no incentive for the PAs to use concessions as management tools (Buckley 2003). Due to added work and personnel costs, and potential issues in implementation, collecting concessions fees for the general treasury could well result in the PAs losing resources. The revenue mechanism in the CUA faced strong opposition from the PAs:

> *We are not some money collectors for the state in general. We are just money collectors for the park. […] I think the best way to do this, to even this gap, is to change the text and the [CUA] law. (P3)*

There are many existing models that could be discussed between the PAs and relevant ministries. For example, the US National Park Service has used a system of 80% of concession revenue kept by the PA and the rest shared with other PAs (Schwartz and Lin 2006). This could provide a starting point for discussions between the PAs and the ministries as not all PAs have the same tourism revenue potential; for example, some PAs do not have tourism demand or visitation can even be prohibited. However, these PAs still need financial resources to achieve their conservation goals. For the future, to prevent further ambiguities and address the root causes of the conflicts in the legal framework, a more coordinated approach between the park agencies and ministries is needed.

Everyman's Rights and Economic Instruments

Equity of access to the PAs, an aspect of social sustainability, was raised by the interviewees. As PAs introduce economic instruments to cover their operating costs, parking and service fees at the most basic level, it has been questioned whether the people's right to enjoy public lands or Nordic everyman's rights are still in effect (Pitas 2020; Øian et al. 2018; Buckley 2003). At the time of the interviews, only SNP did not charge for parking. It is possible to arrive at the PAs by bicycle or use remote free parking lots, but due to the long distances and lack of public transport system serving the PAs, opportunities to enjoy many PAs without paying have become marginal in Iceland.

> *Are we gonna choose which one can go and visit? […] Is it only people that have money, or is everybody [going to] have the opportunity to go visit the park? NP is the park for the nation, so we always have to think about if it's accessible for everybody… (P6)*

Recent studies indicate that the Icelandic public is in favor of charging visitor fees to cover the costs of the PA management (Government of Iceland 2022; Reynisdottir et al. 2008). The public's positive outlook towards fees may be linked to the high share of foreign tourists visiting the PAs—over 97% of the visitors at the study sites (author, unpublished data)—having them pay for the usage is seen as fair by locals, who would otherwise pay for the PA management via taxes.

Regarding the debate between everyman's rights and commercial activities, the legal framework gives a clear signal with the park-specific laws and the CUA stating all business activities need a concession and thus cannot operate within everyman's rights. While the law is clear on the boundaries of commercial operations, interviewees raised the issue that it is still a "mental or behavioral challenge" for the companies, as people in Iceland are used to roaming free and not having any restrictions for their nature-tourism businesses. Registration of all businesses operating in the PAs to a single database would also work towards sensitizing the companies to operate under the framework and regulations of the concessions as suggested by an interviewee.

Lessons Learned in the PA Policy Instrument Context

Reflecting on the results in an international PA context provides some important observations. In a Nordic perspective, we can make some critical observations regarding many of the recommendations of the recent policy instrument review (Øian et al. 2018). First, user fees in the

Icelandic PAs have not encountered major legal, political or ideological challenges. This applies for both end-user fees such as parking or service fees, and fees charged per client from businesses in regulated activities. In fact, this was the preferred way according to the businesses. However, challenges in implementing fees we observed in a co-managed PA due to conflicts of interest in the board composition.

Second, though at a nascent stage, the Icelandic concession system is utilized at all levels, providing a useful reference for development for the Nordics and other countries with rights to roam. Concessions in Iceland have been primarily set up for revenue and visitor safety purposes, and to structure visitor streams at certain sites. Limits for group sizes have been set, but no caps to limit the total number of visitors have yet been implemented despite attempts. Nordic concession policy analysis warns that if revenues and visitor limitations are the key drivers for concessions, the economic dimension may dominate over the social and environmental ones (Øian et al. 2018). The results indicate Iceland is currently a fitting example of this concern. However, the interviewees seem aware of this shortcoming and cite the legal framework currently having limited scope beyond economic criteria as the main challenge. Since the legal framework is new and the concession system in PAs is still being introduced, supporting policies and regulations can have a significant impact on guiding the implementation. Holistic sustainability should be addressed in the employment policies of the PAs, and if necessary, by further changes to the laws. It is encouraging that the motivation to regulate tourism businesses in Iceland has grown organically from visitor safety and experience needs.

Finally, observations regarding long-term development of the concession system can be drawn from countries pioneering PA concessions. New Zealand introduced concession legislation in the 1980s, so system has had decades to mature. However, an evaluation by Dinica (2017) points to many weaknesses that have a clear reference to the emerging system in Iceland and need to be considered in its development: risk of high concession fees forcing out local operators, insufficient revenues from concessions to have a real impact on conservation goals, legal framework that lacks a holistic approach, absence of meaningful environmental responsibilities in concessionaires' contracts, and a demand-oriented approach where tourism needs guide development instead of conservation priorities.

Similarly, a difficult issue with large-scale concessions in the US NPs, transfer of contracts and an appropriate residual value of concessions at the end of the contract, is undefined in the Icelandic legislation (Roddewig 2021). The CUA states that the Minister may provide further regulation on this, or it can be negotiated by contract as is currently the case, but unresolved this issue is likely to cause further conflicts in the future. On one of end the spectrum are market prices and on the other the South African model, where the concession facilities revert to the state at the end of the contract (Wyman et al. 2011). This is an important question for policy, are concessions part of the market-based tourism infrastructure or wider conservation infrastructure, which eventually should be in the hands of the PA? As Buckley notes, 'parks are assets for tourism, but not tourism assets' (Buckley 2009).

Conclusions

Concessions are important instruments for tourism management in PAs but an understudied topic. This study illustrates various opportunities and constraints in the process of introducing concessions to PA management. The need for concessions was triggered by the rapid growth of nature-based tourism in Iceland, as currently experienced across many PAs in the world, and the insights can support other sites in the same process.

Our study shows that the emerging concession system in the Icelandic NPs has developed the necessary legal framework and tools to manage the growth and pressures from commercial tourism. At the same time, traditional Nordic everyman's rights have remained largely unaffected. Stakeholder interviews communicate a general agreement over the introduction of the concession system. Businesses understand the need for regulation for limited resources and are willing to pay for services and rights to use the land in the PAs. Businesses preferred per customer fees as a fair way for the PAs to charge for commercial tours but call for longer contracts than are currently provided. For the PAs, concessions are an important opportunity for revenue-generation to strengthen infrastructure and staffing and are used to ensure better visitor experience and safety via the contract requirements and regulations. However, the emerging concession system currently lacks a holistic sustainability perspective, and the PAs plan to introduce further concession criteria supporting environmental and social goals. Key legislation might need to be revised to give these factors more weight over the price-offer and ensure sustainability factors are fully factored in. Clear government policies guiding the tender decision-making in this direction can act as the first step.

Constraints were experienced in the capacity of the PAs to implement effective concession contracts, roll out concessions across all geographical areas and activities as required by the legislative frameworks, and carry out effective monitoring. These observations reinforce findings from international studies highlighting how managing a concession system requires significant workforce, expertise and strategic decision-making, and raise the question whether the legislative updates have been met with a matching

increase in capacity. A particularly challenging issue in the Icelandic context was how the countryside PAs could support community interests and local businesses without conflicting general administrative law on equal treatment of all businesses. Focusing on the price-offer risks alienating and marginalizing small businesses. Further legal clarifications are needed to resolve the overlaps between general and site-specific laws regarding concession revenue collection and distribution, and to provide punitive measures for contract breaches. These challenges illustrate issues to consider for other countries beginning to implement their concession systems.

Concessions are an effective way for the PAs to allocate rights, collect additional revenues for management efforts and regulate visitor flows. However, this study shows that the process is not as simple as putting a price-tag for business activities in the parks. Concessions are complex economic instruments and often involve difficult social and environmental questions, requiring expertise and experimentation to get the conditions right, both for the PAs and the businesses.

Data availability

The data that support the findings of this study are not openly available due to reasons of sensitivity and are available from the corresponding author upon reasonable request.

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Compliance with ethical standards

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Context for the case study, legal overview and use of concessions in Icelandic protected areas

Contextual information for the study

Protected areas (PAs) are a major land use category in Iceland with 130 units covering ca. 23% of its terrestrial area (Government of Iceland, 2022; Umhverfisstofnun, 2023; Hagstofa, 2024). All PAs are established through the government. In most cases, the process follows the Nature Conservation Act, whereby the Nature Conservation Agency carries out the preparation, drafts the terms of protection and defines the site boundaries (Petursson et al., 2016). This is followed by a consultation period. Once the parties have agreed to the terms, the proposal is submitted to the Minister of the Environment. Some PAs have also been established through site-specific legislation allowing more contextual tailoring, e.g. co-management in the case Vatnajökull National Park (Siltanen et al., 2022).

The study focuses on Iceland's three national parks (NPs): Þingvellir (ÞNP), Snæfellsjökull (SNP) and Vatnajökull (VNP). VNP was originally managed by an autonomous government agency and merged with The Environment Agency of Iceland on 1.1.2025, forming the new Nature Conservation Agency of Iceland (Icelandic Parliament, 2024). SNP was originally managed by the Environment Agency and currently by the Nature Conservation Agency. ÞNP is managed by an autonomous government agency. A detailed overview of the study sites is provided in Table S1.1.

Table S1.1. Overview of the study sites

Site	Key feature(s)	Visitor numbers (2023)	Main commercial activities	Key legislation
Vatnajökull NP Southern Region *3,762 km² (total 14,967 km²)* 350 km from Reykjavík	Some of nation's most popular sites; glacial lagoons and outlets. Many hiking routes to the surrounding mountains and glacier edges. World Heritage Site (nature).	Breiðamerkursandur: ca. 1 million overall (Þórhallsdóttir and Ólafsson, 2024)	*Regulated*: Ice cave tours, glacial hikes, food services and cafeterias. *Unregulated*: glacial lagoon boat rides, sightseeing tours.	Park-specific acts: No. 60/2007 No. 101/2016 No. 300/2020 Act on commercial use of public lands: No. 100/2021
Snæfellsjökull NP *183 km²* 200 km from Reykjavík	Snæfellsjökull glacier and volcano. Unique volcanic landscapes by the sea.	Ca. 400-450,000 overall (Environment Agency of Iceland, 2022)	*Regulated*: Lava cave tour, glacial hikes (if needs infrastructure), cafeteria. *Unregulated*: sightseeing tours.	Nature Conservation Act: No. 60/2013 Act on commercial use of public lands: No. 100/2021
Þingvellir NP *237 km²* 50 km from Reykjavík	Historical parliament site, and rift valley between tectonic plates. World Heritage site (culture).	Ca. 1.5 million overall (personal communication, 9.2.2024)	*Regulated*: Snorkelling and diving tours, cafeterias. *Unregulated*: sightseeing tours.	Park-specific acts: No. 47/2004 No. 85/2019 Act on commercial use of public lands: No. 100/2021

Legal framework for concessions in Iceland

In the Nordic countries, people have historically and culturally rooted rights to enter public and private lands for recreation or passage, codified in slightly differing laws on everyman's rights (Robertson, 2011; Tuulentie and Rantala, 2013). In Iceland, the Nature Conservation Act (NCA) allows visitors to enter uncultivated lands without motorized vehicles and camp without permission for one night if they are not near settlements; however, visitors must show consideration to the environment and landowners can restrict movement to some degree (Icelandic Parliament, 2013). In specific areas, such as PAs, overnight camping and other activities can be further regulated with specific laws and by-laws. The NCA also allows for collecting fees for licenses, services and damages of natural areas but the fees may not be higher than the actual costs of the services provided (Icelandic Parliament, 2013). The NCA does not separate visitors between private individuals or commercial groups but does set a maximum of three tents that are allowed to camp with permission. However, from a legal perspective, a person carrying out a recreational activity as a private individual is always distinguishable from a person carrying out the same activity as a commercial or organized tour client (Buckley, 2003).

The most recent addition to the national legal framework for concessions, law 100/2021 on the utilization of state-owned land for commercial purposes, subsequently referred to as CUA (commercial use act), was designed to promote the use of public lands for economic activities, covering state-owned lands, NPs and other PAs. All commercial activities on these lands are prohibited without a concession agreement. The law states that the value of state-owned land must be maximized as much as possible through effective management via concessions, management leases and licenses taking into account sustainability and other environmental considerations. The CUA is managed by the Ministry of Finance, and revenues from the contracts are collected for the state treasury, unless they are directly related to a statutory role or core tasks of the licensor (e.g. PA authority), in which case the share of incomes to the licensor and treasury will be separately assessed. The CUA provides a legally-binding obligation for carrying out an assessment of all relevant activities within the scope of the law during the first five years. (Icelandic Parliament, 2021)

As the NCA did not provide sufficient means of regulating commercial business activities, ÞNP and VNP, with park-specific legislations, implemented their own legislative updates to manage commercial activities in the PAs prior to CUA. ÞNP made changes to its legislation with law 85/2019, stating that no business-related activities can be run in the park without the approval of the Þingvellir committee, and the park may charge fees for contracts that cover the costs of licensing, management and supervision of the activity; and further rules will be formulated in the park's employment policy (Icelandic Parliament, 2019). The original act on VNP 60/2007 and subsequent modification in law 101/2016 (Icelandic Parliament, 2007; 2016) state that supporting employment-generating activities in VNP is one of the park's core objectives, and defines in detail how the park should regulate the activities by tenders, licenses and permits. According to VNP regulation 300/2020, all commercial activities need an agreement with the PA; and for limited resources, the park board should accept the most economical tender offer according to the publicized criteria (Government of Iceland, 2020). Article 9 in the CUA states that the site-specific laws of ÞNP and VNP take precedence over the general law regarding utilization contracts (Icelandic Parliament, 2021). SNP operates under the NCA and CUA without park-specific legislation.

Overview of the current concession system in Iceland

Concessions system currently used by the Icelandic NPs is presented in Table S1.2. There are currently two full-scale concessions in VNP that predate the national park and were originally formed with the municipality. A new setup for the Jökulsárlón concession is currently being negotiated and is expected to become the largest concession by monetary value in the country (Government of Iceland, 2024). The Vatnshellir lava cave

tours concession in SNP is currently the only full-scale concession in Iceland set up by a PA authority. Several cafes, restaurants and food carts are run by leases or management contracts at all NPs.

Activities requiring a license from the PA authority currently cover ice cave tours and glacier hikes in VNP and glacier hikes in SNP, if the operation requires fixed infrastructure. Diving and snorkeling activities at Silfra in ÞNP are similar; the companies operating at the Silfra need to fulfill conditions set in the park regulations and apply for guide licenses from the Icelandic Transport Authority, which regulates scuba diving in Iceland. Additionally, a daily Silfra permit must be purchased for each guest. ÞNP also issues daily fishing permits. Otherwise, permits are typically used for filming, drone flying and research in Iceland. Other fees are charged for parking and services, camping and exhibitions.

Various pricing models for the concessions are used: flat annual concession fees, monthly rent and revenue shares, processing fees based on the size of the project or license, and per person or per day fees. Current disclosed fees for leases and existing large-scale concessions are low, for example restaurants or cafeterias receiving hundreds of visitors a day paying less than a month's rent for a small apartment in the capital region (205.337 ISK / 1.375€) (Central Bank of Iceland, 2025; Icelandic Housing and Construction Authority, 2025). Activities subject to licenses and permits are relatively well-developed. However, it's notable that activities such as glacier hiking and ice cave tours, significant industrial activities around the Jökulsárlón glacier lagoon, companies currently need to pay only a small annual fee based for the processing of the license and a small fee per visitor in the future (Þórhallsdóttir and Ólafsson, 2024; Vatnajökull National Park, 2024a). The per person fee at Silfra provides more significant revenues for the PA in comparison. Though not a concession according to the definition (2017), most visitors encounter the economic instruments in the PAs via parking and service fees, which are currently used in ÞNP and the South region of VNP. Daily parking fees vary between 1000 ISK (6.7€) for a personal car up to 8,500 ISK (56.9€) for large buses (Thingvellir National Park, 2024; Vatnajökull National Park, 2024b; Central Bank of Iceland, 2025).

Table S1.2. Overview of economic instruments applied in Icelandic NPs

Site	**Concession**	**Description**	**Fees** Reference exchange rates: 1€ = 149.31 ISK, $1 = 137.93 ISK (Central Bank of Iceland, 2025)	**Duration**
Full-scale concessions				
VNP	Fjallsárlón	Lease of land and exclusive use of the lagoon, contract originally between municipality and landowner before VNP inherited. No conditions on activities and services; currently restaurant, lagoon tours, lagoon accommodation.	9.5 mISK per year	12 years
	Jökulsárlón café & shop, amphibian tours in the lagoon	Lease of land, exclusivity for amphibian tours; current contract originally with the landowners, which park inherited. Type and number of boats limited.	Not disclosed; new concession setup and contract under formulation.	Original contract: ~25 years New: n/a
SNP	Vatnshellir lava cave	Lava cave tour requiring infrastructure for safe access	Permit processing fee + 200,000 ISK / month + 10.5% of revenue	3 years with 2 year extension option
ÞNP	None			

Leases / management contracts				
VNP	Food services at Jökulsárlón	Food carts at the Jökulsárlón parking lot, currently 3 companies (Vatnajökull National Park, 2024c)	179,000 ISK per month + 50,000 ISK for electricity	2 years
	Restaurant at Skaftafell center	Lease of restaurant space at visitor center, open tender	Monthly rent, not disclosed	1 year
SNP	Accommodation at Gufuskálar	Lease of buildings within PA from municipality; PA not involved	n/a	n/a
	Restaurant at Hellissandur visitor center	Restaurant/café at the new visitor center, open tender	200,000 ISK / month + 10% of revenue	1 year with 1 year extension
ÞNP	Cafeterias at the visitor center and service center	Two cafeterias (exclusivity in the park), open tender	n/a	n/a
Licensed activities				
VNP	Glacier hiking and ice cave tours	Need to apply for an annual license with VNP, currently 24 companies (Vatnajökull National Park, 2024c)	100,000 ISK + 100 ISK pp 2024-2025; 200 ISK pp 2025-2026 onwards	1 year
SNP	Glacier tours *with fixed equipment or facilities*	Glacier hiking tours to the summit	39,400 ISK	2 years
Activities subject to permit				
VNP	Recreational drone flying (exc. some highland sites)	Pre-approved permit needed with 10d notice	Free	Per activity, typically day(s)
	Commercial filming Events / activities Landing aircrafts	Pre-approved permit needed with 14/30d notice	25,000 or 50,000 ISK (based on project size) 16,000 ISK/h specialist 12,000 ISK/h ranger	"
	Research permit	Pre-approved permit needed with 30d notice	Free	"
SNP	Drone flying by private individuals in up to 2 PAs	Pre-approved permits needed for various activities within the park	38,000 ISK	Per activity, typically day(s) to month(s)
	Work, activities, events, research	"	57,000 ISK	"
	Construction, filming and/or photography	"	76,000 ISK	"
ÞNP	Silfra snorkeling/scuba diving	Per person fee and a set of conditions and regulations for operation	1,500 ISK pp (waived for guides on tours)	Per day
	Fishing permit	Day-fee (annual card available)	2,500 ISK pp	"
	Commercial filming permit	Pre-approved permit needed with 7/30d notice depending on size of project	n/a (cost of park supervision if needed)	Per activity, typically day(s)

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Supplemental tables

Table S2.1. Overview of interviewees from public administration and companies

Site	Public admin. *(invited)*	Companies *(invited)*	Total
Vatnajökull NP (Skaftafell/Jökulsárlón)	5 (7)	8 (31)	13 (38)
Snæfellsjökull NP	2 (3)	1 (3)	3 (6)
Þingvellir NP	2 (2)	3 (6)	5 (8)
Total	9 (12)	12 (40)	21 (52)

Table S2.2. Details of stakeholder interviews

Date	Stakeholder type	Code	Length (min)	Informed consent
14.11.2023	Business	B1	46	Yes
17.11.2023	Business	B2	37	Yes
17.11.2023	Business	B3	17	Yes
18.11.2023	Park authority	P1	39	Yes
22.11.2023	Park authority	P2	27	Yes
22.11.2023	Park authority	P3	35	Yes
22.11.2023	Park authority	P4	32	Yes
22.11.2023	Park authority associate	P5	39	Yes
23.11.2023	Business (2 interviewees)	B3, B4	31	Yes
27.11.2023	Business	B5	35	Yes
1.12.2023	Business	B6	23	Yes
1.12.2023	Business	B7	26	Yes
7.12.2023	Park authority (2 interviewees)	P6, P7	50	Yes
11.12.2023	Business	B8	50	Yes
12.12.2023	Business	B9	40	Yes
15.12.2023	Business	B10	41	Yes
11.1.2024	Park authority (2 interviewees)	P8, P9	63	Yes
27.3.2024	Business	B11	36	Yes

Table S2.3. Summary of stakeholder perceptions on opportunities and constraints of concessions

Opportunities	**Constraints**
Large-scale concessions	
• Means to build needed infrastructure where government won't invest. • Business opportunity • Concession fees can provide significant funding. • Splitting large-scale concessions to manage PA risk and provide opportunities for a larger number of companies.	• Monetary focus on tender criteria in the CUA. • Smaller companies cannot partake in tenders. • Interpretation between CUA and park-specific laws unclear. • Single large-scale concession owners are difficult for the PA in case of non-conformance. • Current concession contracts provide limited funding for the PAs.
Leases / management contracts	
• Means to provide services and infrastructure not in the interest of PAs. • Terms of the contracts used to steer businesses for better environmental standards.	• Contracts currently issued are too short for the companies.
Licences	
• Opportunity to regulate areas designated for commercial activities while protecting the rest. • Requirements have increased quality of tourism services, visitor experience and safety. • Provide a holistic picture of commercial activities in the PA. • All PA tourism operators should be in one national database. • Threat of non-renewal can function as a deterrent for violations.	• Currently issued mostly annually, lack of foresight for companies and cumbersome work for the park. • Current implementation limited to certain areas and activities; companies deem unfair that they need to obtain a licence when others don't. • Licences are issued for a nominal processing fee, no income for PAs. • Lack of workforce to monitor. • Lack of punitive capacity for breaches.
Permits	
• Per person fees for permits seen as a fair approach for everyone. • Provides control of activities and PA funding. • Issuing a limited number of permits could provide means for regulating capped activities without having to tender large-scale concessions.	• According to the general and park-specific laws, such fees can only apply against the costs of the activity; tourism companies argue they are used for other purposes as well. • Lack of workforce to monitor activities requiring permits.

Semi-structured interview outlines

Interviews with tourism stakeholders

- INTRO: Tell about recording and transcription. Ask if there are any questions about the study.
- INTRO: Please you state your name, company and position. Where is your company based? How would you shortly describe your company? Size of the company?
- RQ2: Describe your business activities in the NPs. How (if any) are the activities currently regulated by the PA?
- RQ2: Is it necessary to regulate business activities in the parks? If so, why?
- RQ2: What do you see as the: 1) strengths, and 2) weaknesses of the current regulatory framework from the perspective of your business?
    - Discuss the framework itself vs. its application, enforcement and monitoring?
    - Discuss applicable instruments separately: 1) Permits, licenses and fees, 2) leases, and 3) concessions.
- RQ2 / RQ3: In the recent years, PA legislation in Iceland has moved from fees covering park operational costs to generating revenue for the state for the use of public lands through various arrangements, e.g. VNP amendment in 2016 and the new law from the Ministry of Finance (100/2021). These changes imply that companies should in the future be ready to pay more for running activities in the parks.
    - What 1) opportunities and 2) threats this presents to your business?
    - Think of the Fjallsárlón concession (though current agreement predate the national park). It can be example of the future to come. How do you see this development in the Icelandic context?
- RQ3: If a concession model was implemented to regulate your main activity, how should it be set up from the business perspective?
    - You can consider the effects of capped visitor numbers, exclusivity of contracts, longevity of the business, employment effects, cost of investments and licenses, support for local businesses, …?
- RQ2/3: Any other points or concerns to add to the topic?

Interviews with park managers and directors

- INTRO: State your name and position. How does your job link with management of the business activities?
- RQ2: Is it necessary to regulate business activities in the parks? If so, why?
- RQ1/RQ2: What are the 1) strengths, and 2) weaknesses of the current legal framework to regulate economic activities?
    - What are the most significant day-to-day challenges in applying the laws?
    - What 1) opportunities and 2) threats do you see in the implementation for the parks?
- RQ2: Briefly describe the current laws that are applied in your NP to regulate economic activities.
    - If your NP has a park-specific law, how are activities to be regulated between the park-specific legislation and the 100/2021 law?
    - From the perspective of your NP, does it have an effect that the revenues from law 100/2021 -agreements are collected by the treasury and not the park?
- RQ3: If a commercial activity in the PAs has a limited capacity (e.g. number of people who can participate per day), what are the best ways in your opinion to regulate it?
- RQ3: There is a shift in the legislation from fees covering operational costs to generating revenue from the use of public lands, how do you see this development regarding the management of the PA?
- RQ2/RQ3: How should parks use the funds that come from the concessions?
- RQ2/RQ3: Regarding the full-scale concessions, what should be the role of the park and role of the concessionaire?
- RQ3: What recommendations or lessons learnt can you draw so far from implementing economic instruments at your PA?
- RQ3: Park-specific questions regarding employment policy (currently only VNP):
    - What is the status of the employment policy? Has it supported the regulation and generation of employment activities? Are any further policy or legal amendments necessary?
- RQ1/RQ2/RQ3: Any other points or concerns to add?

Paper IV

Challenges in achieving a global standard for protected area management effectiveness in the context of sustainability: analysis of the IUCN Green List

Abstract

Protected Area (PA) management effectiveness is a cornerstone of global biodiversity conservation, yet standardised tools for evaluating effectiveness and PA sustainability remain limited. This study investigates the potential of the IUCN Green List Standard (GLS) and its self-assessment tool to support PA management and evaluate sustainability, using Iceland's three National Parks as a pioneering case study, both for the self-assessment tool and the Arctic region. Through semi-structured interviews with PA managers and a structured self-assessment exercise, the study evaluates the GLS and self-assessment tool's usability, relevance, and alignment towards management effectiveness and sustainability goals. The results indicate that the GLS provides a comprehensive and reflective framework for assessing governance, planning, and conservation outcomes. PA managers found the self-assessment tool useful for identifying strengths and areas for improvement. The assessment revealed limited integration of ecosystem services and ecological integrity in existing management plans, and PA managers noted geodiversity and related processes largely missing from the GLS indicators. The study explores the Green List's potential as a sustainability framework by presenting it within the sustainability pillars and mapping its criteria to the United Nations' Sustainable Development Goals (SDGs). While the GLS aligns well with environmental and governance dimensions, it could provide more specific criteria for climate change mitigation and socio-economic integration. Nonetheless, the Green List offers a promising global standard for evaluating PA management effectiveness and sustainability, particularly if adapted to regional contexts. These findings contribute to ongoing efforts to improve conservation quality under the Kunming-Montreal Global Biodiversity Framework Target 3.

Keywords

Protected area management; national parks; management effectiveness; sustainability; IUCN Green List; self-assessment; Kunming-Montreal Global Biodiversity Framework

Highlights

- The IUCN Green List (GL) is a comprehensive framework for management effectiveness.
- As a sustainability standard, the GL is balanced but could be more ambitious.
- The GL contributes to 12 SDGs and aligns well with Kunming-Montreal GBF Target 3.
- Icelandic case study highlighted the lack of geodiversity in the GL indicators.

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1. Introduction

Area-based conservation is the primary strategy for conserving biodiversity and nature in general through Protected and Conserved Areas (PCAs) (Woodley et al., 2019). However, the majority of PCAs have not been evaluated on whether they achieve their conservation goals and 'paper parks' exist, potentially increasingly so due to the rapid expansion of the Protected Area (PA) estate (Di Minin & Toivonen, 2015; UNEP-WCMC and IUCN, 2024; Visconti et al., 2019; Watson et al., 2014). The Kunming-Montreal Global Biodiversity Framework (KMGBF) Target 3 calls for 30% of the land and seas to be brought under area-based conservation before 2030. The target also requests the parties to ensure effective conservation and equitable management by 2030; thus, it is urgent, concurrently with expanding the area-based conservation estate, to analyse and evaluate their effectiveness in achieving conservation goals (CBD, 2022).

Protected Area Management Effectiveness (PAME) evaluation describes the process of planning, implementing, evaluating and improving different aspects of PA management in a continuous cycle, similar to the concept of adaptive management (Hockings et al., 2006). However, most commonly used frameworks are based on PA managers' subjective opinions on ordinal scales, lack systematic reviews and do not necessarily fulfil conditions for rigorous scientific studies or conclusions (Coad et al., 2015). As a result, it is difficult to draw conclusions or make comparisons from the evaluations in the Global Database on PA Management Effectiveness (GD-PAME), developed to follow progress on management effectiveness towards the Convention on Biological Diversity (CBD) objectives (Stolton et al., 2019). Before the current Target 3 was set, a shared quality benchmark for management effectiveness evaluations was called for, e.g. by Gannon et al. (2019); however, a reference or standard was not specified in the KMGBF Decision (CBD, 2022). According to GD-PAME and the MPA Guide, currently 6.8% of terrestrial and 1.26% of marine PAs have been assessed for management effectiveness using 75 methodologies, highlighting both the diversity of assessment tools and the urgency of expanding assessment efforts globally to reach the KMGBF Target 3 (Sullivan-Stack et al., 2024; UNEP-WCMC and IUCN, 2024).

The International Union for Conservation of Nature (IUCN) recognised the challenge in trying to measure global progress with a wide variety of methods and developed a voluntary accreditation system with the IUCN World Commission on Protected Areas (IUCN-WCPA) to act as a global unifying standard for management effectiveness: the IUCN Green List of Protected and Conserved Areas Standard (Hockings et al., 2019; IUCN-WCPA, 2017). As of October 2025, there are 102 certified sites and over 60 countries including candidate applications that are participating in the program. However, with over 300,000 PCAs across the globe, scaling-up the level of adoption is still a challenge for the program (Hockings et al., 2019; IUCN, n.d.-b; UNEP-WCMC and IUCN, 2024).

The IUCN is committed to aligning the Green List with the ISEAL Alliance Codes of Good Practice in order to also develop it into an accredited global sustainability standard (IUCN-WCPA, 2017; IUCN-WCPA & ASI, 2019). Hockings et al. (2019) call it the first global sustainability standard for area-based conservation. However, the Green List documentation makes limited use of sustainability beyond aiming for compliance to ISEAL sustainability standard, defined as 'a standard that addresses the social, environmental or economic practices of a defined entity, or a combination of these' (IUCN-WCPA, 2017, p. 5). PAs globally are striving to become effectively managed and sustainable but lack tools and frameworks to guide work efforts in these different perspectives (Ghoddousi et al., 2022). Conceptual discussion between management effectiveness and sustainability is needed to

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understand how the simultaneous pursuit of management effectiveness and sustainability can be delivered and evaluated through practical frameworks designed for PAs.

To encourage adoption and interest in the program, the IUCN initially developed a Green List Improvement Benchmarking and Evaluation Index (IBEX) assessment tool (UNEP-WCMC and IUCN, 2022), allowing PCAs to conduct a preliminary self-assessment towards the Green List; either as the first step towards the Green List candidacy and certification, or as an internal tool for benchmarking and improving management effectiveness. The IBEX-tool was used during the development and piloting phase, and the final Green List Self-Assessment Tool (GL-SAT) was officially announced at the IUCN World Conservation Congress in October 2025 (IUCN, 2025b). Once released, the GL-SAT will be a free and openly available web-based tool.

In cooperation with the IUCN and Icelandic National Parks (NPs), this study evaluates a pre-release version of the Green List self-assessment tool and interviews PA managers to provide insights on using the Green List to improve and ensure management effectiveness and sustainability. Iceland provides an interesting case study as it is located in the sub-Arctic where the Green List has not yet been applied, all three Icelandic NPs operate under different governance arrangements (Siltanen et al., 2022). This also serves as a pioneering study of global relevance on the experiences of PA managers using the Green List IBEX-tool.

This study aims to answer the following research questions (RQs):

1. How does the IUCN Green List Standard (GLS) and the self-assessment tool contribute towards PA management effectiveness?
2. How suitable is the IUCN Green List as a sustainability standard for PAs?

Drawing on RQ1 and RQ2, the study explores policy implications and recommendations for advancing PA management effectiveness and sustainability globally.

2. Materials and methods

2.1. Analytical framework

2.1.1. International agreements

The CBD is the primary international treaty for biodiversity conservation, and the KMGBF was adopted by the CBD Parties in 2022 as its latest strategic implementation plan (Stephens, 2023). KMGBF Target 3 sets the 30% by 2030 terrestrial and marine PA target but also calls for focus on areas of particular importance for biodiversity and ecosystem services, effective governance and management, recognising the rights of indigenous peoples and local communities, and providing opportunities for sustainable use (CBD, 2022). Experiences with the preceding 2010 Aichi Biodiversity Targets showed that many countries focused on the quantitative area-based targets with global loss of biodiversity accelerating despite increasing PA coverage; thus it is now critical to focus on the quality PA expansion, governance and management, and measuring progress with the right indicators (Pulido-Chadid et al., 2023; Stephens, 2023; Watson et al., 2023). Several challenges in implementing the KMGBF have been identified, e.g. linkages to sustainable development, recognition and integration of local stakeholders, and lack of indicators for effective

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management (Hughes & Grumbine, 2023; Li et al., 2023). Scientific committees of the CBD have been working on guidance for disaggregated indicators of Target 3 (CBD, 2024a, 2024b; UN-WCMC, 2024).

2.1.2. From management effectiveness towards sustainability

Protected areas (PAs) form the core of area-based conservation efforts, supplemented by Other Effective Area-based Conservation Measures (OECMs) (Jonas et al., 2023; Woodley et al., 2019). Investing in PAs requires that they can be effective in producing long term conservation outcomes (Hockings, 2003). Development of various management effectiveness frameworks began in the mid-1990s, with the first PA management effectiveness (PAME) framework from the IUCN-WCPA being published in 2000 (Hockings et al., 2006).

In PAME, the management effectiveness evaluation is defined as the extent to which it is protecting values and achieving the goals and objectives it was established to protect. The PAME framework did not come with pre-set criteria, instead guiding PAs to develop an assessment system over six elements: context, planning, inputs, processes, outputs and outcomes. The framework provides some examples of concepts to be considered in the assessment: ecosystem services, biodiversity, landscape and geological formations, research and education, and cultural, social and economic values. (Hockings et al., 2006)

Concurrently with the introduction of the initial PAME framework, various indicator sets and national and international evaluation tools were quickly developed by international NGOs, government agencies and researchers; for example, the widely-used Rapid Assessment and Prioritization of PA Management (RAPPAM) and the Management Effectiveness Tracking Tool (METT) (Hockings et al., 2014; Leverington et al., 2010; Leverington et al., 2008; Nolte et al., 2010). PAME approaches have been criticised for focusing too much on the management processes, lacking on outcome analysis and specific issues such as climate change and ecosystem services, and suffering from potential stakeholder bias as the evaluations are often filled in by PA staff only (Bialowolski et al., 2023; Cook et al., 2014; Ervin, 2011; Stolton et al., 2019).

Many assessment methodologies have been developed in response to the emerging needs or shortcomings of the original PAME-framework. For example, adding social and economic indicators from sustainable development and -tourism models (Bialowolski et al., 2023; Hummel et al., 2021; Leverington et al., 2008; Stoll-Kleemann, 2010), cultural indicators in the case of World Heritage sites (UNESCO et al., 2023), and even a wetland-specific R-METT tool for Ramsar sites (Munguía & Heinen, 2021). Chen et al. (2023) has compiled a comprehensive review of the assessment approaches and guidelines for the suitability of applying various evaluations.

The Global Database on Protected Area Management Effectiveness (GD-PAME) was launched in 2006 to collect all PA evaluations globally and provide a platform for monitoring, reporting and forming comparisons (UNEP-WCMC, 2017). GD-PAME is used for reporting PA management effectiveness on several global agreements and reports, e.g. CBD agreements, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the Protected Planet reports (UNEP-WCMC, 2017); however, the diversity of the evaluations has made it difficult to track global progress (UNEP-WCMC and IUCN, 2022). A global information system for PAs has been called for to address this

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(Hoffmann, 2022), and recent update to GD-PAME now prompts all evaluations to answer a set of standardised questions to allow monitoring of KMGBF Target 3 progress using the database (UNEP-WCMC, 2025).

As KMGBF Target 3 also encourages sustainable use of biodiversity and PA resources, it has been recognised that significant growth in the global PA estate is likely impossible without supporting socio-economic objectives (Bhola et al., 2021; CBD, 2022; Dinerstein et al., 2020; Sandbrook et al., 2023; Woodley et al., 2019). PAs thus need to be able to respond to developments and challenges across all the environmental, social and economic dimensions of sustainability, calling for a wider set of analysis criteria beyond what is traditionally covered by management effectiveness assessments.

2.1.3. Sustainability in a PA context

To analyse the PAs in the context of sustainability, it is necessary to first define the concept. Salas-Zapata and Ortiz-Muñoz (2019) identified four meanings from scientific studies: 1) a set of social-ecological criteria to guide action, 2) a vision or goal for humankind to integrate social, environmental and economic expectations, 3) an object described as a reference system or other terms such as resilience, adaptability, balance, etc., and 4) a study approach to analyse social, environmental and economic variables. In the context of PAs, all four meanings have been used; e.g. in providing social-ecological criteria (Ghoddousi et al., 2022), a goal for integrating socio-economic and conservation objectives (Gatiso et al., 2022), or a platform for analysing the different dimensions of sustainability (Lee & Abdullah, 2024). The Green List is an example of a reference system of a ‘sustainable PA’ (IUCN-WCPA, 2017).

Sustainability is commonly represented as three overlapping circles or pillars, comprised of social, environmental and economic dimensions (Purvis et al., 2019). The IUCN referred to the integration of the three domains already in the 1980 World Conservation Strategy (IUCN et al., 1980). The strategy was evaluated at the 1986 IUCN Conference on Conservation and Development, with a conclusion that sustainable development in the conservation context seeks to integrate conservation and development, satisfaction of basic human needs, achievement of equity and social justice, provision of social self-determination and cultural diversity, and maintenance of ecological integrity (Jacobs et al., 1987; Purvis et al., 2019).

Kuhlman and Farrington (2010) criticise the three-dimensional approach to sustainability by arguing that social and economic dimensions are in fact the same, concerned with the well-being and current needs of societies, while the environmental dimension is concerned with irreplaceable natural resources and the well-being of future generations. This approach is consistent with the concepts of weak and strong sustainability: the former describing natural resources that can be substituted with man-made capital and the latter defining essential, non-replaceable resources closer to the conservation context (ibid). However, several studies also criticise treating nature and human interactions separately as most natural environments have been historically shaped by human presence and co-evolution, e.g. (Rodríguez-Darias & Díaz-Rodríguez, 2023; Sarmiento-Mateos et al., 2019). For PA sustainability, these are essential discussions and emphasise evaluating environmental factors with a focus on long-term conservation together with socio-economic factors.

The United Nations’ Sustainable Development Goals (SDGs) have been set to be attained by 2030 (UN, 2015), and PAs have been identified to contribute to many, hence life on land (15) and below water (14), zero hunger (2), clean water and sanitation (6), climate (13), health and well-being (3), sustainable communities (11), poverty (1), inequality reduction (5 and 10)

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and peace and justice (16) (Dudley et al., 2017; Dudley et al., 2022; Kettunen et al., 2021). Furthermore, recent studies demonstrate more explicitly how PAs contribute to the SDGs (Al-Saedi & Syakir, 2023; Liu et al., 2023; McCarthy et al., 2025; Zhao et al., 2025).

However, there is still a lack of comprehensive sustainability frameworks adapted for PAs. Some aspects of sustainability in a PA context have been studied, for example, various aspects of social sustainability, sustainable tourism and finance, e.g. (Bohorquez et al., 2023; Corrigan et al., 2018; Latinopoulos & Vagiona, 2013; Sobhani et al., 2022; Trišić et al., 2023; Zafra-Calvo et al., 2019; Zafra-Calvo et al., 2017; Zhang et al., 2022). Case studies also exist, e.g. (Lee & Abdullah, 2024; Marques et al., 2013; Mitchell et al., 2013; Smith et al., 2021). Overall, the needs to reconcile the needs of nature protection and socio-economic development and local participation for effective PA management are widely highlighted, e.g. (Dawson et al., 2024; Gatiso et al., 2022; Hoffmann, 2022; Jones et al., 2023; Oldekop et al., 2016; Siltanen, 2026). As Nyaupane et al. (2022, p. 2702) highlight, 'a thorough reform is needed to change the mindset of policymakers and park officials for them to consider locals and other stakeholders as equal partners in protected area conservation'.

2.1.4. IUCN Green List, an evolving global management effectiveness and sustainability standard

The IUCN-WCPA developed the Green List of Protected and Conserved Areas (GLPCA) to act as a global standard for PA management effectiveness and sustainability through extensive consultation and testing (Hockings et al., 2019; IUCN-WCPA, 2017; Wells et al., 2016). As part of this process, UNEP-WCMC and IUCN (2022) conducted an analysis on how the GLPCA compares to other commonly used assessment frameworks. The Green List works as both a process and conservation outcome standard, built on 50 indicators, organised under 17 criteria and 4 main components of good governance, sound design and planning, effective management, and successful conservation outcomes (Figure 1) (IUCN-WCPA, 2017). Initially, PAs must show evidence of fulfilling five basic indicators to enter the candidate phase, during which they will work with the Expert Assessment group for the Green List (EAGL) to demonstrate evidence for passing all indicators to achieve the Green List status, which is subject to renewal every five years (IUCN-WCPA & ASI, 2019). Indicators may be adapted to a local context subject to an approval process with the EAGL (ibid). The Green List is promoted as a voluntary management effectiveness standard by CBD Decision XIII/2 (IUCN-WCPA, 2024).

The IUCN initially developed the Green List IBEX self-assessment tool as a development prototype to allow participating PCAs to assess compliance with the Green List criteria. The official Green List Self-Assessment Tool (GL-SAT) was announced at the IUCN World Conservation Congress in October 2025 as a free and openly available web-based tool (IUCN, 2025b). The IBEX-tool was an interactive Excel-sheet, covering all indicators with a set of yes/no/partially questions to help a PA manager to indicatively assess whether their PA fulfils each criterion. It also provided examples of means of verification for each criterion to advice what kind of proof the PA could use in the applicant or candidacy phases of the Green List application. Based on the answers, the tool calculated an indicative component and overall score for how well the PA matches with the Green List criteria. The self-assessments can serve PCAs to develop their management effectiveness, with or without the intention to apply for the official certification. (Personal communication, IUCN webinars,

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13.2.2025 & 23.4.2025)



Figure 1. IUCN Green List components and criteria (IUCN-WCPA, 2017)

The Green List seeks external accreditation by aiming to comply with the ISEAL (International Social and Environmental Accreditation and Labelling Alliance) Codes of Good Practice and Credibility Principles (IUCN-WCPA & ASI, 2019). The ISEAL Alliance is a voluntary sustainability standard (VSS) provider with origins in the international NGO movement for social and environmental justice (Freistein et al., 2022). The ISEAL Code describes how standards, performance requirements and claims should be set and managed, and how standards are properly assured, monitored, evaluated and benchmarked (ISEAL, 2025a, 2025b, 2025c). ISEAL's standards do not directly influence the content of its members' standards; instead, it provides a procedural standard and credibility with external partners (Loconto & Fouilleux, 2014). Research shows that VSSs are becoming mainstream global governance instruments and suggests that the direct impact of the ISEAL standards has been limited, but they have been successful as shared learning platforms and tools for external certification (Derkx & Glasbergen, 2014; Paiement, 2016). The increase of VVSs led OECD & ITC (2024) to produce a typology of sustainability initiatives, following initial definitions from the United Nations Forum on Sustainability Standards (UNFSS, 2012).

2.2. Methodology

2.2.1. Icelandic case study

PAs are a major land use category in Iceland covering ca. 23% of its terrestrial area in 130 units (Environmental Agency of Iceland, 2024; Government of Iceland, 2022). Most PAs are managed by the Nature Conservation Agency (Icelandic Parliament, 2024). However, various governance arrangements are in place and tourism has been identified as the main management challenge, with international visitor numbers soaring from 500,000 to over 2 million per annum in just a few years (Hjálmarsdóttir & Óskarsson, 2025; Siltanen et al., 2022). This study focuses on Iceland's three National PAs: Þingvellir (ÞNP), Snæfellsjökull

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(SNP) and Vatnajökull (VNP), all popular sites for nature-based tourism; see Figure 2 for locations and

Table **1** for details.

Iceland established a national management effectiveness survey with 27 indicators derived from the METT assessment tool in 2017 (Environment Agency of Iceland, n.d.). An evaluation of the condition of popular tourist sites in PAs has since taken place annually, covering 144 sites in the latest report (Environmental Agency of Iceland, 2024). Each indicator is scored between 1-10; average scores over 8 are classified as green, in good condition and responding well to visitation pressures, while scores under 5 are classified as red, in immediate risk of losing conservation values and in urgent need of interventions (ibid). Most of the locations within the NPs in the case study have a green status in the latest evaluation (ibid).

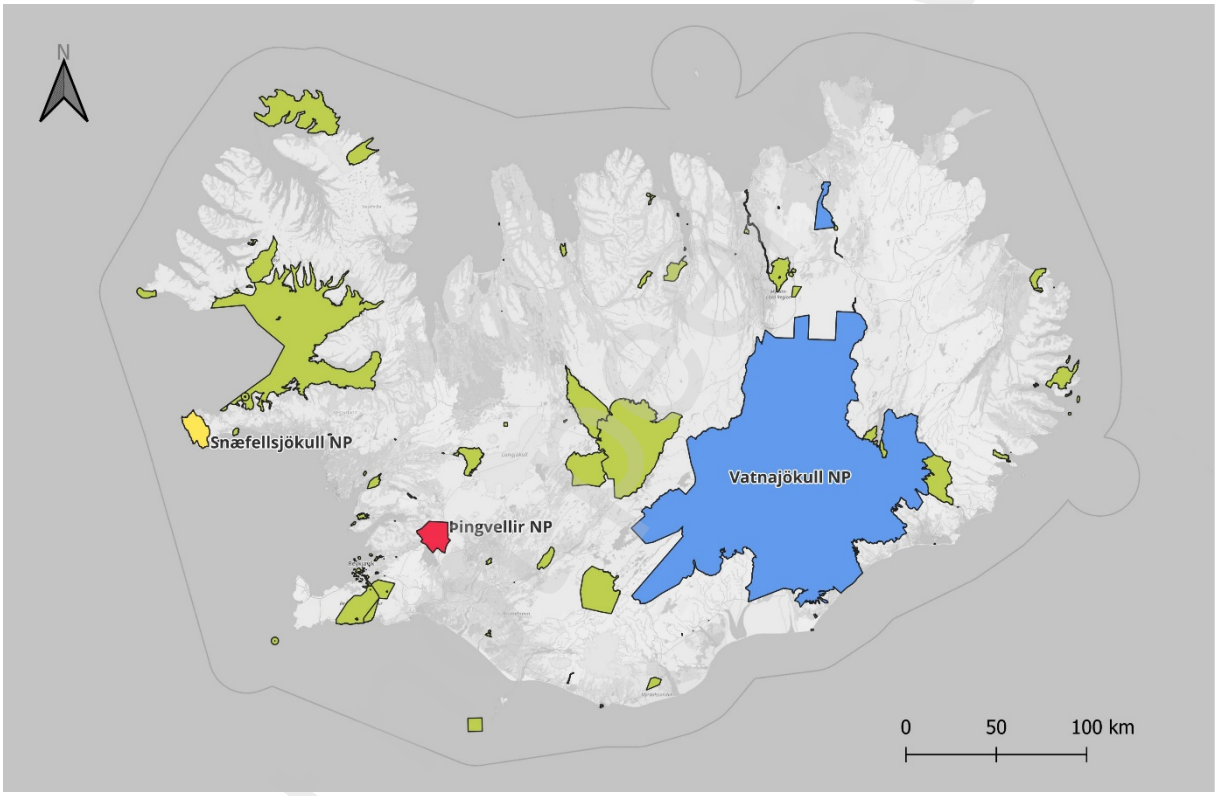


Figure 2. The Iceland's PAs and the three NP study sites

Table 1. The three NP study sites

Site	Key feature(s)	Governance	Visitor numbers
Vatnajökull NP *14,967 km²* 350 km from Reykjavík	Popular glacial lagoons and outlets in the South. Extensive highland and mountain areas. UNESCO World Heritage Site for nature.	Co-management approach; four regions each with a regional council of local stakeholders, one main board. Managed by the Nature Conservation Agency.	South region of Vatnajökull: ca. 1 million overall (Þórhallsdóttir & Ólafsson, 2024)

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Site	Key feature(s)	Governance	Visitor numbers
Snæfellsjökull NP *183 km²* 200 km from Reykjavík	Snæfellsjökull glacier and volcano. Unique volcanic landscapes by the sea. Within the UNESCO Man and Biosphere Reserve.	Centralised supported by a local advisory board. Managed by the Nature Conservation Agency.	Ca. 400-450,000 overall (Environment Agency of Iceland, 2022)
Þingvellir NP *237 km²* 50 km from Reykjavík	Historical parliament site and rift valley between tectonic plates. UNESCO World Heritage Site for culture.	Centralised. Managed by a dedicated government agency.	Ca. 1.5 million overall (personal communication, 9.2.2024)

2.2.2. Self-assessment experiment and expert interviews

This inquiry employed a qualitative study using semi-structured interviews to elicit answers to the RQs (Figure 3). The intention was for all participants to have practical experience with the Green List to share their experiences and views regarding it. As the self-assessment tool was in development by the IUCN at the time of the research project, and not publicly available, the authors worked in collaboration with the IUCN's Green List team based in Gland, Switzerland.

First, an introductory 1.5-hour webinar on the Green List was organised, hosted by IUCN Green List experts. The webinar also included a short introduction to the research project. An invitation to the webinar was sent to PA managers at all levels in the three NPs. After the first webinar, participants were asked if they wanted to participate in the research project, which would include another training webinar in the use of the IBEX-tool, completion of the self-assessment for their PA, and participation in a research interview afterwards. All volunteers were welcomed to take part. The IBEX-tool used in the experiment was an Excel-based prototype, hosted by the IUCN on their servers.

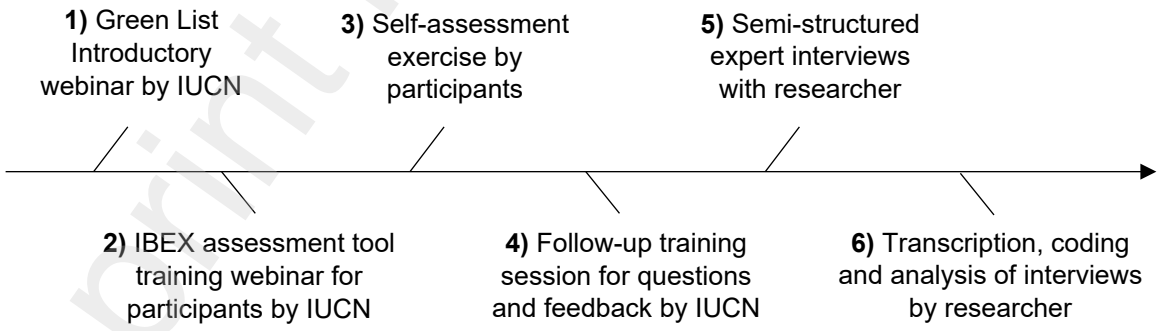


Figure 3. Steps and responsibilities in the study methodology

Five PA managers were interviewed in total (P1-5), representing all NPs; all except one had experience in filling in the annual national management effectiveness surveys. Due to the large size and various regions of VNP, three managers who had worked in several regions were interviewed for increased geographical coverage of potential local issues. Interviews

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were carried out using a semi-structured and open-ended question guide (Appendix A). The guide was used to obtain responses consistent with the RQs and to allow new views to emerge (Adams, 2015). As is customary in qualitative research, informed consent was obtained from all participants before the study. Icelandic was the mother tongue of four interviewees, though they regularly use English at their work. One manager was a native English-speaker. Interviews varied between 44-79 minutes and were all held online in English, recorded and transcribed in Microsoft Teams. Transcriptions were then manually reviewed and corrected for any errors.

Transcribed data was coded using a top-down elaborative with Taquette, an open-source qualitative data analysis application (Auerbach & Silverstein, 2003; Rampin & Rampin, 2021). Transcripts were analysed two times. First, excerpts were highlighted and grouped into themes linked to the RQs and Green List criteria. Recurring topics emerging from the interviews were also highlighted. Excerpts in each theme were then analysed together for alignment, insights or differing perspectives between the respondents. The interview data was utilised to elicit observations and insights from the PA managers regarding the contribution of the Green List and IBEX-tool towards the management effectiveness of their PAs, and as a sustainability evaluation tool, following the study scope defined by the RQs.

2.2.3. Linkages between the UN Sustainable Development Goals and the Green List

In order to evaluate the Green List as a sustainability standard (RQ2), the Green List criteria were placed within the sustainability pillars. This study also explored how they are linked to the SDGs to assess comprehensiveness of the SDG coverage in a similar approach to Cook et al. (2023). While the IUCN provides SDG references to the GLS (IUCN, n.d.-a), the rationale or methodology for the linkages is not provided, and thus it was seen not sufficient and evidence-based for the analytical purposes of this paper.

Figure 4 illustrates the matching process between the SDGs and the GLS in this study. An Excel-version of the SDG indicators was used (UNSD, 2025), and for each Green List criterion, suitable SDG targets were identified first. Then an examination was conducted on which SDG indicator(s) could potentially accommodate the Green List indicators. If a suitable SDG indicator was found, the SDG was referenced in the relevant sustainability pillar for the Green List criterion (Figure 5). A detailed matching sheet is provided in Appendix B.

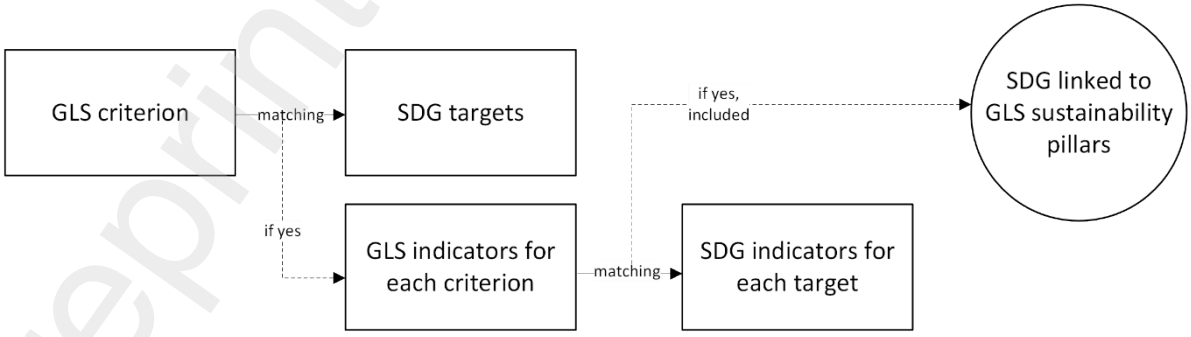


Figure 4. Matching process for the UN Sustainable Development Goals and Green List linkages

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3. Results and discussion

3.1. The Green List's contribution to management effectiveness

3.1.1. Overall experiences of using the IBEX self-assessment tool

As this is a pioneering study using the IBEX-tool, the PA managers were asked to elaborate on their experiences of using the IBEX-tool prototype. This was also the first time the managers were using the Green List to evaluate the management effectiveness of their PA. A general observation from all the PA managers was strikingly similar, as they found the Green List and the IBEX-tool to constitute an in-depth dive into the management of their sites, and said many questions made them reflect on topics they generally do not think about in their daily work (P1, P2, P3, P4, P5). They generally found the tool easy to use; however, they also commented that many terms were quite technical, and some questions were difficult to understand, prompting the managers to look for translations and examples (P1, P2, P3, P5). The guiding questions and tooltips in the prototype helped to provide some practical context, and it was suggested to include a glossary and use simpler language (P1, P3, P5).

The managers found that the IBEX-tool provided a critical eye over the areas they manage; it was useful to know where they were doing well and important to get a list of topics they could improve (P1, P3). All saw the dashboard view showing overall alignment with the Green List as a useful illustration (P1, P2, P3, P4, P5). The IBEX-tool highlighted how important a comprehensive management plan is for a PA, as managers used it as a reference for the assessment questions (P1, P3). The five-year interval for the Green List assessment renewals was also thought to be appropriate as it takes time to implement changes and improvements in the different indicators (P5).

3.1.2. Results of the self-assessment component-by-component

PA manager observations regarding management effectiveness were systematically explored, component-by-component (Figure 1). The first component covers governance issues such as legitimacy, transparency, accountability and adaptability. The interviewees found the Green List evaluation supportive of the co-management systems, and they highlighted the value of involving the local communities (P1, P2, P3, P4, P5). Furthermore, the Green List was seen as a global benchmark of good governance (P1, P2, P4), one that is safeguarding the value of the co-management model (P3, P4). On the other hand, in the Icelandic PA system there are many locations without local communities around the PA, and in some cases, questions regarding stakeholder interactions were found to be excessive (P5).

The second component of the Green List covers the identification and conservation of major site values (MSVs) and understanding threats, challenges and socio-economic context.

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Some gaps were revealed in the interviews regarding this component. Interviewees stated that the PAs have not yet clearly identified ecosystem services and assessed ecological integrity in the management plans (P1, P2, P3). This is partly related to the varied geography and geology of the PAs featuring glaciers and volcanic highlands, where biodiversity is often invisible to the eye, but slow geological processes create conditions for biodiversity within the PAs and elsewhere (P1, P2, P3). Accounting for such geodiversity and gaining better understanding of its contribution to biodiversity and ecological integrity could come better forth in the Green List indicators (P2, P3), though it is mentioned in the guidance notes of the GLS (IUCN-WCPA, 2017). In that sense the Green List is pointing at this analytical work to be completed; recent ES research in similar contexts could provide useful starting points (Cook et al., 2022; Malinauskaite et al., 2025).

The self-assessment helped the managers realise that research within the PAs regarding biodiversity, geology and other environmental issues is often carried out by other government agencies or universities, and there is currently no formal path for that information to return to the PA in a way that could be used for management and monitoring purposes (P1, P2, P3). Climate change and high visitor numbers were identified as the main threats, but managers felt their impacts were difficult to assess due to the unpredictability of climate events and the energy spent on core visitor management at the most visited sites (P1, P2). It was also noted how climate change intersects with cultural and socio-economic impacts as the glaciers provide both emotional and historical value and employment opportunities for the local communities, and how difficult it was to try capture such interactions with the assessment tool (P1).

The third component of the Green List calls for implementing a strategy to manage the ecological condition, socio-economic context and threats, effectively manage visitation and resource-use, enforce regulations and measure progress. Lastly, the fourth component consists of criteria and indicators to demonstrate conservation of MSVs, ecosystem services and cultural values. The interviewees made similar observations as in regarding design and planning, seeing the PAs more focused on visitor management than conservation work, partly due to the role of other national research institutions in ecological monitoring, and visitor management constituting the main effort in protecting delicate landscapes and ecosystems in mass tourism areas (P1, P3). One NP had experience in setting thresholds for critical environmental changes, and managers from the other sites agreed that the information necessary to evaluate environmental and ecological changes and set thresholds exists but requires further cooperation with the research agencies to be embedded into PA management processes (P1, P2, P3, P5). Overall, the Green List was seen as a comprehensive benchmark of effective PA management and verified by third-party evaluation (P1, P2, P3, P4).

3.2. The Green List as a sustainability framework

Sustainability in PA management elicited more varied responses from the interviewees than management effectiveness. Several managers questioned whether it was possible to be truly sustainable in relation to mass tourism and related issues such as carbon-intensive travel, carrying capacity, crowding, erosion and waste management (P1, P3, P5). These views relate to critical studies on using PA tourism for sustainable development, which suggest that PAs may in some cases enhance unsustainable models of production and consumption (Rodríguez-Darias & Díaz-Rodríguez, 2023). Managers also saw some daily operations as being unsustainable, e.g. using gas-heated huts and heavy modified vehicles in the highlands; however, no alternatives were seen to be available currently (P2, P3).

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Overall, the interviewees expressed that many systems were in place to increase operational sustainability. Newer visitor centres are BREEAM-certified to reduce carbon dioxide emissions from infrastructure, regular vehicles are electric and the Green Steps Program (Icelandic Environment and Energy Agency, 2025b) is used for green accounting and reducing waste and emissions for all government organisations in Iceland (P2, P3, P5). All NPs in this study have reached the highest level in the program, which entails having an environmental management system similar to ISO 14001, a comprehensive green accounting program, and an environmental and climate policy with targets and an associated action plan (Icelandic Environment and Energy Agency, 2025a, 2025c). In the green accounting program all material purchases, energy, fuel and waste and the associated carbon dioxide emissions are recorded. This enables a good overall picture of the sustainability of the operations and helps to monitor whether emissions are decreasing or increasing (P5). These actions aim to minimise the direct environmental impact of visitation and daily operations but cannot measure the visitors' own activity such as driving or participating in tours (P5). Education efforts on climate change and the environment could also be seen as sustainability initiatives (P5).

Various aspects of social sustainability were also raised by the managers, such as using local knowledge to solve issues, providing business and job opportunities and making decisions that are acceptable to the surrounding communities (P1, P2, P3). Sustainable use of resources, e.g. harvesting or farming, is studied and defined in the management plans in collaboration with relevant research institutes (P3). Managing business activities has been challenging and managers have experienced that some companies operating in the NPs are focused on sustainability while others endeavour solely for profit (P1), raising conflicts of interest regarding the beneficiaries and questioning how PAs can successfully steer the sustainability of business activities (Siltanen, 2026).

To analyse the Green List in a wider sustainability context, the interactions of the Green List and relevant SDGs were placed into the sustainability framework depicted in Figure 5. The Green List criteria were compared to the SDGs and their indicators to see which SDGs could be covered by the Green List and contributed to by the PAs (see chapter 2.2.3 and Appendix B for further details). Some SDGs could be linked to several pillars but are displayed once in the most relevant. The environment, socio-economic and governance (ESG) pillar-approach of Lee and Abdullah (2024) is followed. Guidelines from the OECD & ITC (2024) for VSSs suggest evaluating governance as a separate sustainability pillar and this approach is also widely used in ESG reporting by organisations (Bosi et al., 2022).

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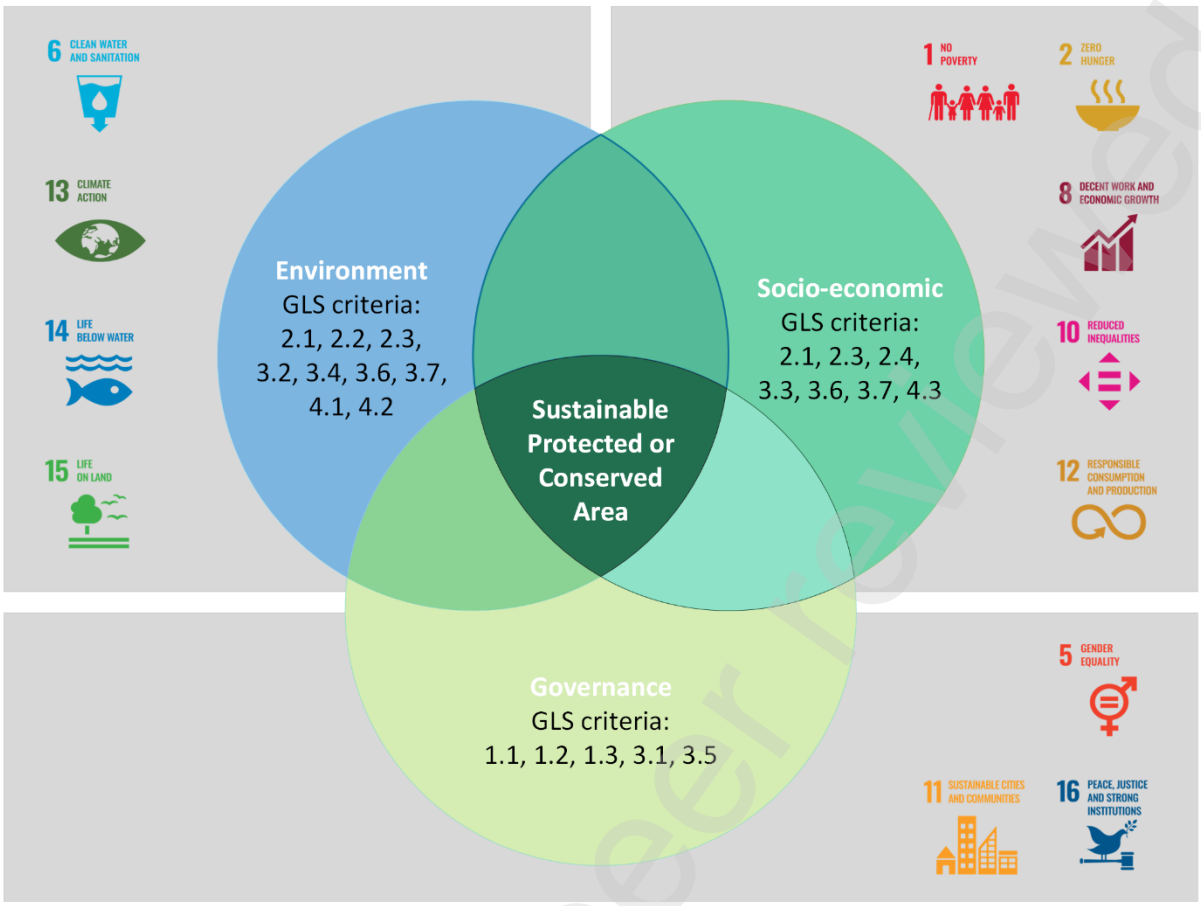


Figure 5. IUCN Green List Standard (GLS) indicators and SDGs in a sustainability framework

Figure 5 illustrates a relatively even distribution of the GLS criteria into the sustainability pillars, as well as linkages to most SDGs. Most of the criteria and SDGs are in the environmental and socio-economic pillars. Governance-related Green List criteria connect with SDG indicators for the goals of gender equality (5), sustainable cities and communities (11) and strong institutions (16). Environmental criteria reference the SDGs on clean water and sanitation (6), climate action (13) and life on land (15) and below water (14). Socio-economic criteria support the SDGs on ending poverty (1) and hunger (2), reduced inequalities (10), decent work and economic growth (8), and responsible consumption and production (12). These linkages support the IUCN intention of establishing the Green List as a sustainability management standard for the PAs and connecting them to broader global goals.

The analysis presented in Figure 5 also supports the application of the GLS as an analytical tool in terms of all four meanings of sustainability introduced in the analytical framework (Salas-Zapata & Ortiz-Muñoz, 2019). The GLS criteria cover all the dimensions and proposed indicators of social-ecological systems (Ghoddousi et al., 2022) as well as sustainability pillar related indicators (Lee & Abdullah, 2024), and call for integrating socio-economic and conservation goals (Gatiso et al., 2022). These findings reinforce the notion of the Green List as a reference for ‘sustainable PA’.

However, our case study provides some examples where it could be possible to advance sustainability further. Use of a green accounting system allows the Icelandic PAs to monitor and reduce greenhouse gas emissions and impacts from all operations-related matter and energy flows, while the only direct Green List reference to operational sustainability, indicator 3.6.4, calls for visitor services to meet reasonable standards of environmental sustainability

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(IUCN-WCPA, 2017). Regarding climate change, Green List indicators 1.3.4 and 2.3.2 (ibid) call for PAs to evaluate the potential impacts of climate change on socio-ecological conditions and conservation values but lack specific criteria for mitigation approaches, such as being key sites for climate education especially in the Arctic (P2, P5), using adaptive mitigation strategies, providing opportunities for carbon sequestration and working parallel to the climate targets (Cheung et al., 2024; Dinerstein et al., 2017; Gillingham et al., 2024; Melillo et al., 2016; Múnera-Roldán et al., 2024).

Finally, the indicators under Green List criteria 2.4 and 3.3 call for the socio-economic context to be identified and incorporated into site management, with enhancement 'considered' if compatible with conservation goals (IUCN-WCPA, 2017). These wordings lack ambition and a full acknowledgement of the importance of socio-economic perspectives to successful PA management and sustainability, replicating a sub-optimal biocratic approach to PA management (Gatiso et al., 2022; Oldekop et al., 2016; Rodríguez-Darias & Díaz-Rodríguez, 2023; Sarmiento-Mateos et al., 2019).

3.3. Policy implications

3.3.1. National perspectives

Our case study provides some insights regarding the goodness of fit of the Green List within national PAME-frameworks. As described in chapter 2.2.1, Iceland employs a METT-derived assessment tool, currently covering 144 PA sites in an annual survey. However, all the PA managers found the Green List to be a markedly different evaluation. While the national survey is a site-based evaluation of organisation, infrastructure and conservation values, the Green List provides a broader and more in-depth analysis of governance, stakeholder participation and ecological targets (P3, P5). It was suggested that the tool could provide a common reference for governance and site management for the PAs under the responsibility of Iceland's Nature Conservation Agency (P1, P3, P4). The managers also noted that the Green List could provide a useful overall assessment towards the UNESCO sites' reviews (P3, P5). However, the managers perceived that the Green List may lack detail on individual sites or regions, especially in the context of large PAs, providing a complementary perspective to the national assessments (P2, P4). The issue of scale is relevant also in the other end, where the managers questioned whether very small PAs were suitable for the Green List assessment (P3, P4, P5).

Additionally, other benefits were recognised related to the global scope of the standard. Managers saw benchmarking and learning from other PAs on the Green List as an important opportunity (P1, P2, P4). They believed that using the standard could support communication with the local communities, showing how PAs everywhere in the world are aiming for similar goals and interactions and potentially helping people and communities feel proud of their PA (P1, P2, P4). The Green List was also seen as a potential tool for applying for funding as a verified proof of working processes and conservation outcomes (P3, P4), and it could provide global momentum and encouragement for countries to improve their PAs (P1, P3). Thus, both local and global incentives for PAs to apply the Green List were recognised.

3.3.2. Regional differences

This study provides initial experiences of using the Green List in the sub-Arctic region, and experiences shared by the PA managers provide some new considerations in this context.

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Most prominently, the focus of Icelandic PAs on geology and related processes was highlighted with limited reference points in the Green List (P1, P2, P3). This suggests a need to consider amplifying the role of these biodiversity building blocks in the Green List and setting more emphasis in evaluating ecosystem services in the Arctic PAs where these studies are yet to be completed (Kalinauskas et al., 2024). This calls for new research and cooperation projects between the PAs and research institutions, as PAs often do not have specialised staff in such assessments, particularly in the small PA management agencies and units in the Arctic (P2, P3). Existing studies on PA ES evaluations have shown benefits to management effectiveness and can guide process, e.g. (Schirpke et al., 2017).

PA managers also noted that many PAs in Arctic regions are very remote with few or no inhabitants, and thus they are a challenge to manage both due to remoteness, but also from a governance perspective in some cases where there are no local stakeholders (P3, P5). The Green List seems to work from a premise that there are always local stakeholders present and could provide better guidance on how to evaluate its indicators when this is not the case (P5). Research shows that climate change and resulting social and environmental changes are happening faster in the Arctic than anywhere else in the world (Ford et al., 2021; Irrgang et al., 2022). PA managers provided examples of climate change -induced events, such as coastal flooding, but mentioned that they have very little control over such events on a site level and they are difficult to prepare for (P1, P2). The Green List calls for assessing the impacts of climate change on the conservation values of sites in criterion 2.3, but it would be a reasonable requirement to ask for preparation or adaptation measures following the principles of adaptive management, e.g. (Cumming et al., 2015; Schultz et al., 2015). For example, if species ranges or habitats protected by the PA are shifting due to climate change, this should be considered in the long-term plans; or if climate change causes new hazards to visitors or communities within the PA, these should be mitigated in the planning.

3.3.3. Global targets

As introduced in chapter 2.1.1, the KMGBF Target 3 places emphasis on important biodiversity areas, ecosystem services, local rights-holders and sustainable use of resources in a conservation context. The scope of the Green List matches these focal points very well, which is commendable since the current version (1.1) of the GLS was released earlier (IUCN-WCPA, 2017). It calls for setting goals and thresholds on biodiversity and ecosystem services as the main ecological metrics and tries to ensure with an extensive set of indicators that the rights of local stakeholders are ensured in decision-making. Setting thresholds to recognise successful outcomes or shortcomings, potentially prompting immediate action, is a critical feature of the Green List, and while it can initially be a difficult exercise for the PA managers, it provides necessary rigor for the conservation efforts.

Overall, this study supports the assertion that the Green List is a comprehensive and timely framework for management effectiveness. As this study is not a comparison of frameworks, it is acknowledged that there can be others equally suitable for the task. The question perhaps is then, why would a PA use the Green List? There can be two paths to this. As an openly available tool, the GL-SAT allows PAs to evaluate where they stand in terms of the global standard and how they could improve over the years, even if they are not ready for the certification process (Glatz-Jorde et al., 2020; Hockings et al., 2019). As the GD-PAME reporting tool now strongly encourages PAs to respond to standardised questions regarding management effectiveness to monitor global progress towards KMGBF Target 3, completing the Green List self-assessment tool would also cover those questions.

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The independent third-party evaluation and certification by the EAGL is a feature that distinguishes the Green List from other frameworks (Bancheva-Preslavska, 2025). The third-party evaluation and certification are a practical way of ensuring a PA is not a 'paper park', though this comes with a burden of additional work effort for the PA staff (P1, P3, P4). The certification also has implications regarding the transparency and validity for the new standardised effectiveness data in the GD-PAME database and the disaggregated indicators for KMGBF Target 3 (UN-WCMC, 2024; UNEP-WCMC, 2025); without an independent evaluation, it is questionable whether the standardised data can still provide an unbiased overview on the effectiveness of the world's PAs. However, any standardised data on global PA management effectiveness is an improvement over the current situation where no such centralised data exists, and it is implausible to expect independent third-party evaluations for the world's over 300,000 PCAs (UNEP-WCMC and IUCN, 2024).

3.4. Limitations and future research

This is a qualitative study based on a single-country NP system, which may constrain the generalisability of the findings. The interviewees made some observations in the wider Arctic context in terms of biomes, geology and sparse populations; however, the scope of the study does not cover indigenous peoples as Iceland does not have an indigenous population. The IBEX tool used was a pre-release prototype, and its final version may differ in functionality and usability. Our sustainability analysis included a subjective matching of Green List criteria to SDG indicators, which is intended to provide a reference or starting point for other researchers; there can be other interpretations due to the wide scope of both the SDG and Green List indicators. Future research could include comparative studies across diverse socio-ecological and governance contexts, particularly indigenous, and assess the expected long-term impact of Green List certification on conservation outcomes. In the Arctic context, it would also be very useful for practitioners to see case studies on applying and measuring the ecosystem services in these areas.

4. Conclusions

This study has evaluated the potential of the IUCN Green List and its IBEX self-assessment tool to enhance PA management effectiveness and assess sustainability, using Iceland's three National Parks as a pioneering case study. Through interviews with PA managers and analysis of the Green List criteria in relation to sustainability pillars and the SDGs, several key conclusions emerge.

First, the Green List and IBEX tool were found to offer a comprehensive and reflective framework for evaluating PA management. PA managers unanimously appreciated the depth and structure of the assessment, which prompted critical thinking about governance, planning, and conservation outcomes. PA managers found the Green List particularly valuable in co-managed PAs, showing value in the governance approach and providing evidence for the local stakeholders to feel proud of their PA. The assessment was seen as a valuable benchmark, highlighting areas for improvement and aligning local practices with global standards, prompting managers to suggest using it as a common reference within the national Nature Conservation Agency.

Second, the Green List provides a balanced framework for analysing PA sustainability. The Green List criteria fit well within the ESG sustainability pillars and contribute to 12 out of 17 SDGs. However, its ambition as a sustainability standard could still be enhanced. Icelandic NPs demonstrated strong operational sustainability through initiatives such as

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comprehensive green accounting, carbon dioxide emission reductions and infrastructure certification, largely surpassing the Green List criteria. Yet broader sustainability challenges experienced by the parks—such as addressing mass tourism and climate change adaptation—would require more contextual tools and indicators. The Green List could also provide a stronger obligation on socio-economic integration. Developing generic global indicators for widely different socio-economical contexts is difficult, and ultimately the EAGL will determine what is sufficient for compliance in each case in the Green List certification process, but the current wording in the GLS relies too much on the aspiration of the EAGL and their short interaction with the stakeholders during the site visit; if the Target 3 of the KMGBF is to be reached, enhancing socio-economic contexts should not be optional.

Third, the study highlighted the importance of regional adaptation. The characteristics of the Icelandic NPs on the edge of the Arctic, including geodiversity focus, remoteness and sparse local populations, challenge some assumptions embedded in the Green List. This underscores the need for flexible implementation and context-sensitive evaluation, particularly in remote or ecologically distinct regions. It is unclear whether these can be accommodated by the EAGLs during the Green List certification process, or whether they should be considered in future updates to the GLS (IUCN, 2025a). Important observations and tasks were also identified for the PAs themselves, as the study highlighted the need to assess ecosystem services and ecological thresholds in the Arctic context, providing suggestions for future studies.

In conclusion, the Green List provides a comprehensive global management effectiveness framework aligned with the Kunming-Montreal Global Biodiversity Framework Target 3. Its structured approach and third-party verification help to ensure that PAs are not merely ‘paper parks’ but actively contribute to biodiversity conservation, equity and sustainable use of natural resources, the core values of the CBD. The self-assessment tool tested in the study was found relatively simple to use and convenient for benchmarking and critical thinking. As a sustainability standard, the perspective changes towards a wider global context and longer-term goals. While the Green List displays a balanced distribution of the criteria in the ESG sustainability pillars and linkages to most of the SDGs, it lacks aspiration and emphasis on the socio-economic criteria, perhaps due to its roots as an environmental resource management framework. However, as the first global sustainability standard for PAs, it is a commendable starting point and a useful baseline for sustainability efforts in PAs – no one will stop PAs from going further and future updates to the GLS can increase its ambition.

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Declarations

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Competing interests

The authors have no competing interests to declare.

Ethics approval

Iceland's Scientific Ethics Committee does not require an approval for interviews in social sciences. The privacy rights of human subjects have been observed and an informed consent form informing participants of the study and their rights was obtained from all participants prior to the interviews.

Author contributions

Removed for peer-review.

Data availability

The data that support the findings of this study are not openly available due to reasons of sensitivity and are available from the corresponding author upon reasonable request.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work the author(s) used M365 Copilot (version bizchat.20251116.40.2) in order to generate the first draft of the abstract. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the published article.

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Semi-structured interview outline

1. The Green List self-assessment exercise:
    a. How did you complete the assessment? Was it by one person or a team? What were the roles/positions of the participants?
    b. How did you find the self-assessment tool in terms of ease of use, understanding the questions/indicators, structure, workload, technical issues, etc.?
    c. How do you see the outcome of the evaluation?
        i. For example, do you feel it identified the strengths of the park and areas to be worked further on?
        ii. Are there any important values to your park missing from the criteria?
        iii. How do you find the 'dashboard' presentation of the outcomes e.g. in terms of usefulness or communication?
        iv. How would you apply the self-assessment results to improve your site's management?
    d. You used a development version of the assessment tool – the final tool will be web-based but likely with similar structure. Would you suggest any improvements for the final version?
    e. What kinds of capacity building or external support would make the biggest difference in helping your site meet the Green List standards?

2. Sustainability and management effectiveness:
    a. In your view, what defines sustainability in Protected Areas, and what key factors make it achievable?
    b. How does sustainability relate to effective and equitable management from your perspective?
    c. What main insights did the self-assessment reveal, and how do you interpret these results for your site's management effectiveness or sustainability?
    d. How are local communities involved in your site's sustainability or management efforts? Would the Green List framework support or complicate this involvement?
    e. Does your PA currently measure sustainability or management effectiveness?
        i. What frameworks or evaluation systems (if any) are you using to measure management effectiveness? How do you see them in terms of evaluating sustainability?
        ii. If your park (or PA system) is already using a systematic management effectiveness evaluation framework (e.g. national, METT, etc.), how would you compare it to the Green List?
        iii. How do you see the Green List standard fitting in your national PA evaluation system? Would it provide added value? If yes, how and where?

3. Target 3: As part of the 30x30 CBF goals, all PAs should be managed effectively and equitably: *Effective management and sustained positive outcomes for biodiversity conservation requires the adoption of appropriate management objectives and processes, governance systems, adequate and appropriate resourcing and consistent monitoring.*
    a. How do you see the role of the Green List in working towards Target 3 nationally and/or globally?

   b. The Green List is the first global standard of management effectiveness and as such, the results can be used to comparisons and benchmarks. How could benchmarking results from the Green List be used at national and global levels to strengthen PA management?
   c. The Green List standard is based on the international verification and accreditation, though the self-assessment tool can also be used standalone. How do you see the added value of the external recognition (e.g. securing funding, political backing, or public support):
      i. to your park
      ii. nationally towards Target 3
      iii. globally.
   d. In your opinion, should Green List accreditation be more closely integrated into national Protected Area policies or funding strategies? If so, how?

4. There is so far limited experience of using the Green List in the arctic or polar areas. What is your experience of the Green List specifically in the context of these areas?
   a. Do you see specific management or sustainability challenges for the PAs in the arctic/polar regions?
   b. To what extent do you think the Green List criteria capture the unique challenges of managing arctic/polar Protected Areas?
   c. From your perspective, what are the biggest challenges to achieving Green List certification for Protected Areas in arctic/polar contexts?
   d. Based on the self-assessment exercise, would you suggest ideas or guidelines for applying the Green List standard in arctic/polar contexts?
   e. According to the IPCC, the arctic/polar areas are warming 2-4 times faster than the rest of the world.
      i. Do you see this as a specific sustainability or management challenge for the PAs in these areas? Does your PA address these rapid climate changes in park management?
      ii. Given how quickly changing environmental conditions, how do you balance long-term management plans with the need to adapt quickly?
      iii. What are the implications of these rapid changes for a sustainability standard and evaluation framework like the Green List?

5. Any other points, comments or questions you would like to add or discuss?

Final list of proposed Sustainable Development Goal indicators*			Green List Standard	
Goals and targets (from the 2030 Agenda)	*Indicators*		*Criteria*	*Indicator(s)*
Goal 1. End poverty in all its forms everywhere				
1.1 By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day	1.1.1 Proportion of population below the international poverty line, by sex, age, employment status and geographical location (urban/rural)		2.4, 3.3., 3.6	2.4.1, 2.4.2, 3.3.1, 3.3.2, 3.6.1, 3.6.2
1.2 By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions	1.2.1 Proportion of population living below the national poverty line, by sex and age		2.4, 3.3., 3.6	2.4.1, 2.4.2, 3.3.1, 3.3.2, 3.6.1, 3.6.2
	1.2.2 Proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions		2.4, 3.3., 3.6	2.4.1, 2.4.2, 3.3.1, 3.3.2, 3.6.1, 3.6.2
1.3 Implement nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable	1.3.1 Proportion of population covered by social protection floors/systems, by sex, distinguishing children, unemployed persons, older persons, persons with disabilities, pregnant women, newborns, work-injury victims and the poor and the vulnerable			
1.4 By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance	1.4.1 Proportion of population living in households with access to basic services			
	1.4.2 Proportion of total adult population with secure tenure rights to land, with legally recognized documentation and who perceive their rights to land as secure, by sex and by type of tenure		1.1	1.1.2, 1.1.3, 1.1.4, 1.1.5
1.5 By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters	1.5.1 Number of deaths, missing persons and persons affected by disaster per 100,000 people[a]			
	1.5.2 Direct disaster economic loss in relation to global gross domestic product (GDP)[a]			
	1.5.3 Number of countries with national and local disaster risk reduction strategies[a]			
1.a Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation, in order to provide adequate and predictable means for developing countries, in particular least developed countries, to implement programmes and policies to end poverty in all its dimensions	1.a.1 Proportion of resources allocated by the government directly to poverty reduction programmes			
	1.a.2 Proportion of total government spending on essential services (education, health and social protection)			
1.b Create sound policy frameworks at the national, regional and international levels, based on pro-poor and gender-sensitive development strategies, to support accelerated investment in poverty eradication actions	1.b.1 Proportion of government recurrent and capital spending to sectors that disproportionately benefit women, the poor and vulnerable groups		2.4	2.4.2
Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture				
2.1 By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round	2.1.1 Prevalence of undernourishment			
	2.1.2 Prevalence of moderate or severe food insecurity in the population, based on the Food Insecurity Experience Scale (FIES)			
2.2 By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in	2.2.1 Prevalence of stunting (height for age <-2 standard deviation from the median of the World Health Organization (WHO) Child Growth Standards) among children under 5 years of age			

Final list of proposed Sustainable Development Goal indicators*			Green List Standard	
Goals and targets (from the 2030 Agenda)	*Indicators*		*Criteria*	*Indicator(s)*
2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons	2.2.2 Prevalence of malnutrition (weight for height >+2 or <-2 standard deviation from the median of the WHO Child Growth Standards) among children under 5 years of age, by type (wasting and overweight)			
2.3 By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment	2.3.1 Volume of production per labour unit by classes of farming/pastoral/forestry enterprise size			
	2.3.2 Average income of small-scale food producers, by sex and indigenous status			
2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality	2.4.1 Proportion of agricultural area under productive and sustainable agriculture		2.4, 3.6	2.4.2, 3.6.1, 3.6.2
2.5 By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed	2.5.1 Number of plant and animal genetic resources for food and agriculture secured in either medium or long-term conservation facilities			
	2.5.2 Proportion of local breeds classified as being at risk, not-at-risk or at unknown level of risk of extinction			
2.a Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries	2.a.1 The agriculture orientation index for government expenditures			
	2.a.2 Total official flows (official development assistance plus other official flows) to the agriculture sector			
2.b Correct and prevent trade restrictions and distortions in world agricultural markets, including through the parallel elimination of all forms of agricultural export subsidies and all export measures with equivalent effect, in accordance with the mandate of the Doha Development Round	2.b.1 Producer Support Estimate			
	2.b.2 Agricultural export subsidies			
2.c Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility	2.c.1 Indicator of food price anomalies			
Goal 3. Ensure healthy lives and promote well-being for all at all ages				
3.1 By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births	3.1.1 Maternal mortality ratio			
	3.1.2 Proportion of births attended by skilled health personnel			
3.2 By 2030, end preventable deaths of newborns and children under 5	3.2.1 Under-five mortality rate			

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Goals and targets (from the 2030 Agenda)	*Indicators*		*Criteria*	*Indicator(s)*
3.2 By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births	3.2.2 Neonatal mortality rate			
3.3 By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases	3.3.1 Number of new HIV infections per 1,000 uninfected population, by sex, age and key populations			
	3.3.2 Tuberculosis incidence per 1,000 population			
	3.3.3 Malaria incidence per 1,000 population			
	3.3.4 Hepatitis B incidence per 100,000 population			
	3.3.5 Number of people requiring interventions against neglected tropical diseases			
3.4 By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being	3.4.1 Mortality rate attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease			
	3.4.2 Suicide mortality rate			
3.5 Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol	3.5.1 Coverage of treatment interventions (pharmacological, psychosocial and rehabilitation and aftercare services) for substance use disorders			
	3.5.2 Harmful use of alcohol, defined according to the national context as alcohol per capita consumption (aged 15 years and older) within a calendar year in litres of pure alcohol			
3.6 By 2020, halve the number of global deaths and injuries from road traffic accidents	3.6.1 Death rate due to road traffic injuries			
3.7 By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes	3.7.1 Proportion of women of reproductive age (aged 15-49 years) who have their need for family planning satisfied with modern methods			
	3.7.2 Adolescent birth rate (aged 10-14 years; aged 15-19 years) per 1,000 women in that age group			
3.8 Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all	3.8.1 Coverage of essential health services (defined as the average coverage of essential services based on tracer interventions that include reproductive, maternal, newborn and child health, infectious diseases, non-communicable diseases and service capacity and access, among the general and the most disadvantaged population)			
	3.8.2 Number of people covered by health insurance or a public health system per 1,000 population			
3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination	3.9.1 Mortality rate attributed to household and ambient air pollution			
	3.9.2 Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH) services)			
	3.9.3 Mortality rate attributed to unintentional poisoning			
3.a Strengthen the implementation of the World Health Organization Framework Convention on Tobacco Control in all countries, as appropriate	3.a.1 Age-standardized prevalence of current tobacco use among persons aged 15 years and older			

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Goals and targets (from the 2030 Agenda)	*Indicators*		*Criteria*	*Indicator(s)*
3.b Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the Agreement on Trade-Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health, and, in particular, provide access to medicines for all	3.b.1 Proportion of the population with access to affordable medicines and vaccines on a sustainable basis			
	3.b.2 Total net official development assistance to medical research and basic health sectors			
3.c Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in least developed countries and small island developing States	3.c.1 Health worker density and distribution			
3.d Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks	3.d.1 International Health Regulations (IHR) capacity and health emergency preparedness			
Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all				
4.1 By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes	4.1.1 Proportion of children and young people: (a) in grades 2/3; (b) at the end of primary; and (c) at the end of lower secondary achieving at least a minimum proficiency level in (i) reading and (ii) mathematics, by sex			
4.2 By 2030, ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education	4.2.1 Proportion of children under 5 years of age who are developmentally on track in health, learning and psychosocial well-being, by sex			
	4.2.2 Participation rate in organized learning (one year before the official primary entry age), by sex			
4.3 By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university	4.3.1 Participation rate of youth and adults in formal and non-formal education and training in the previous 12 months, by sex			
4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship	4.4.1 Proportion of youth and adults with information and communications technology (ICT) skills, by type of skill			
4.5 By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations	4.5.1 Parity indices (female/male, rural/urban, bottom/top wealth quintile and others such as disability status, indigenous peoples and conflict-affected, as data become available) for all education indicators on this list that can be disaggregated			
4.6 By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy	4.6.1 Percentage of population in a given age group achieving at least a fixed level of proficiency in functional (a) literacy and (b) numeracy skills, by sex			

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Goals and targets (from the 2030 Agenda)	*Indicators*		*Criteria*	*Indicator(s)*
4.7 By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development	4.7.1 Extent to which (i) global citizenship education and (ii) education for sustainable development, including gender equality and human rights, are mainstreamed at all levels in: (a) national education policies, (b) curricula, (c) teacher education and (d) student assessment		Note. The Green List has educational indicators that could contribute to target 4.7, but since indicator 4.7.1 focuses on formal education, they were not included here.	
4.a Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all	4.a.1 Proportion of schools with access to: (a) electricity; (b) the Internet for pedagogical purposes; (c) computers for pedagogical purposes; (d) adapted infrastructure and materials for students with disabilities; (e) basic drinking water; (f) single-sex basic sanitation facilities; and (g) basic handwashing facilities (as per the WASH indicator definitions)			
4.b By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries	4.b.1 Volume of official development assistance flows for scholarships by sector and type of study			
4.c By 2030, substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small island developing States	4.c.1 Proportion of teachers in: (a) pre-primary; (b) primary; (c) lower secondary; and (d) upper secondary education who have received at least the minimum organized teacher training (e.g. pedagogical training) pre-service or in-service required for teaching at the relevant level in a given country			
Goal 5. Achieve gender equality and empower all women and girls				
5.1 End all forms of discrimination against all women and girls everywhere	5.1.1 Whether or not legal frameworks are in place to promote, enforce and monitor equality and non-discrimination on the basis of sex		1.1, 3.1	1.1.5, 3.1.5
5.2 Eliminate all forms of violence against all women and girls in the public and private spheres, including trafficking and sexual and other types of exploitation	5.2.1 Proportion of ever-partnered women and girls aged 15 years and older subjected to physical, sexual or psychological violence by a current or former intimate partner in the previous 12 months, by form of violence and by age			
	5.2.2 Proportion of women and girls aged 15 years and older subjected to sexual violence by persons other than an intimate partner in the previous 12 months, by age and place of occurrence			
5.3 Eliminate all harmful practices, such as child, early and forced marriage and female genital mutilation	5.3.1 Proportion of women aged 20-24 years who were married or in a union before age 15 and before age 18			
	5.3.2 Proportion of girls and women aged 15-49 years who have undergone female genital mutilation/cutting, by age			
5.4 Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate	5.4.1 Proportion of time spent on unpaid domestic and care work, by sex, age and location			
5.5 Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political,	5.5.1 Proportion of seats held by women in national parliaments and local governments			

Final list of proposed Sustainable Development Goal indicators*			Green List Standard	
Goals and targets (from the 2030 Agenda)	*Indicators*		*Criteria*	*Indicator(s)*
economic and public life	5.5.2 Proportion of women in managerial positions		1.1, 3.1	1.1.5, 3.1.5
5.6 Ensure universal access to sexual and reproductive health and reproductive rights as agreed in accordance with the Programme of Action of the International Conference on Population and Development and the Beijing Platform for Action and the outcome documents of their review conferences	5.6.1 Proportion of women aged 15-49 years who make their own informed decisions regarding sexual relations, contraceptive use and reproductive health care			
	5.6.2 Number of countries with laws and regulations that guarantee women aged 15-49 years access to sexual and reproductive health care, information and education			
5.a Undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources, in accordance with national laws	5.a.1 (a) Proportion of total agricultural population with ownership or secure rights over agricultural land, by sex; and (b) share of women among owners or rights-bearers of agricultural land, by type of tenure		Note. The Green List criteria could contribute to target 5.a, but was deemed incompatible with related indicators 5.a.1 and 5.a.2, thus excluded.	
	5.a.2 Proportion of countries where the legal framework (including customary law) guarantees women's equal rights to land ownership and/or control			
5.b Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women	5.b.1 Proportion of individuals who own a mobile telephone, by sex			
5.c Adopt and strengthen sound policies and enforceable legislation for the promotion of gender equality and the empowerment of all women and girls at all levels	5.c.1 Proportion of countries with systems to track and make public allocations for gender equality and women's empowerment			
Goal 6. Ensure availability and sustainable management of water and sanitation for all				
6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all	6.1.1 Proportion of population using safely managed drinking water services			
6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations	6.2.1 Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water			
6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	6.3.1 Proportion of wastewater safely treated			
	6.3.2 Proportion of bodies of water with good ambient water quality			
6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity	6.4.1 Change in water-use efficiency over time			
	6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources			
6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate	6.5.1 Degree of integrated water resources management implementation (0-100)			
	6.5.2 Proportion of transboundary basin area with an operational arrangement for water cooperation			
6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes	6.6.1 Change in the extent of water-related ecosystems over time		2.1, 2.2, 4.2	2.1.4, 2.2.1, 2.2.2, 2.2.3, 4.2.1

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Goals and targets (from the 2030 Agenda)	*Indicators*		*Criteria*	*Indicator(s)*
6.a By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies	6.a.1 Amount of water- and sanitation-related official development assistance that is part of a government-coordinated spending plan			
6.b Support and strengthen the participation of local communities in improving water and sanitation management	6.b.1 Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management			
Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all				
7.1 By 2030, ensure universal access to affordable, reliable and modern energy services	7.1.1 Proportion of population with access to electricity			
	7.1.2 Proportion of population with primary reliance on clean fuels and technology			
7.2 By 2030, increase substantially the share of renewable energy in the global energy mix	7.2.1 Renewable energy share in the total final energy consumption			
7.3 By 2030, double the global rate of improvement in energy efficiency	7.3.1 Energy intensity measured in terms of primary energy and GDP			
7.a By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology	7.a.1 Mobilized amount of United States dollars per year starting in 2020 accountable towards the $100 billion commitment			
7.b By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States and landlocked developing countries, in accordance with their respective programmes of support	7.b.1 Investments in energy efficiency as a percentage of GDP and the amount of foreign direct investment in financial transfer for infrastructure and technology to sustainable development services			
Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all				
8.1 Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries	8.1.1 Annual growth rate of real GDP per capita			
8.2 Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors	8.2.1 Annual growth rate of real GDP per employed person			
8.3 Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services	8.3.1 Proportion of informal employment in non-agriculture employment, by sex		2.4, 3.3	2.4.1, 2.4.2, 3.3.1, 3.3.2
8.4 Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic	8.4.1 Material footprint, material footprint per capita, and material footprint per GDP			

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Goals and targets (from the 2030 Agenda)	*Indicators*		*Criteria*	*Indicator(s)*
consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-Year Framework of Programmes on Sustainable Consumption and Production, with developed countries taking the lead	8.4.2 Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP			
8.5 By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value	8.5.1 Average hourly earnings of female and male employees, by occupation, age and persons with disabilities		2.4, 3.3	2.4.1, 2.4.2, 3.3.1, 3.3.2
	8.5.2 Unemployment rate, by sex, age and persons with disabilities		2.4, 3.3	2.4.1, 2.4.2, 3.3.1, 3.3.2
8.6 By 2020, substantially reduce the proportion of youth not in employment, education or training	8.6.1 Proportion of youth (aged 15-24 years) not in education, employment or training			
8.7 Take immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labour, including recruitment and use of child soldiers, and by 2025 end child labour in all its forms	8.7.1 Proportion and number of children aged 5-17 years engaged in child labour, by sex and age			
8.8 Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment	8.8.1 Frequency rates of fatal and non-fatal occupational injuries, by sex and migrant status			
	8.8.2 Increase in national compliance of labour rights (freedom of association and collective bargaining) based on International Labour Organization (ILO) textual sources and national legislation, by sex and migrant status			
8.9 By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products	8.9.1 Tourism direct GDP as a proportion of total GDP and in growth rate		2.4, 3.3	2.4.1, 2.4.2, 3.3.1, 3.3.2
	8.9.2 Number of jobs in tourism industries as a proportion of total jobs and growth rate of jobs, by sex		2.4, 3.3	2.4.1, 2.4.2, 3.3.1, 3.3.2
8.10 Strengthen the capacity of domestic financial institutions to encourage and expand access to banking, insurance and financial services for all	8.10.1 Number of commercial bank branches and automated teller machines (ATMs) per 100,000 adults			
	8.10.2 Proportion of adults (15 years and older) with an account at a bank or other financial institution or with a mobile-money-service provider			
8.a Increase Aid for Trade support for developing countries, in particular least developed countries, including through the Enhanced Integrated Framework for Trade-related Technical Assistance to Least Developed Countries	8.a.1 Aid for Trade commitments and disbursements			
8.b By 2020, develop and operationalize a global strategy for youth employment and implement the Global Jobs Pact of the International Labour Organization	8.b.1 Total government spending in social protection and employment programmes as a proportion of the national budgets and GDP			
Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation				
9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all	9.1.1 Proportion of the rural population who live within 2 km of an all-season road			
	9.1.2 Passenger and freight volumes, by mode of transport			
9.2 Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry's share of employment and gross domestic	9.2.1 Manufacturing value added as a proportion of GDP and per capita			

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Goals and targets (from the 2030 Agenda)	*Indicators*		*Criteria*	*Indicator(s)*
product, in line with national circumstances, and double its share in least developed countries	9.2.2 Manufacturing employment as a proportion of total employment			
9.3 Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets	9.3.1 Proportion of small-scale industries in total industry value added			
	9.3.2 Proportion of small-scale industries with a loan or line of credit			
9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities	9.4.1 CO_2 emission per unit of value added			
9.5 Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending	9.5.1 Research and development expenditure as a proportion of GDP			
	9.5.2 Researchers (in full-time equivalent) per million inhabitants			
9.a Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing States	9.a.1 Total official international support (official development assistance plus other official flows) to infrastructure			
9.b Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities	9.b.1 Proportion of medium and high-tech industry value added in total value added			
9.c Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020	9.c.1 Proportion of population covered by a mobile network, by technology			
Goal 10. Reduce inequality within and among countries				
10.1 By 2030, progressively achieve and sustain income growth of the bottom 40 per cent of the population at a rate higher than the national average	10.1.1 Growth rates of household expenditure or income per capita among the bottom 40 per cent of the population and the total population		2.4, 3.3	2.4.1, 2.4.2, 3.3.1, 3.3.2
10.2 By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status	10.2.1 Proportion of people living below 50 per cent of median income, by age, sex and persons with disabilities		1.1, 3.1	1.1.5, 3.1.5
10.3 Ensure equal opportunity and reduce inequalities of outcome, including by eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies and action in this regard	10.3.1 Proportion of the population reporting having personally felt discriminated against or harassed within the previous 12 months on the basis of a ground of discrimination prohibited under international human rights law			
10.4 Adopt policies, especially fiscal, wage and social protection policies, and progressively achieve greater equality	10.4.1 Labour share of GDP, comprising wages and social protection transfers			

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10.5 Improve the regulation and monitoring of global financial markets and institutions and strengthen the implementation of such regulations	10.5.1 Financial Soundness Indicators			
10.6 Ensure enhanced representation and voice for developing countries in decision-making in global international economic and financial institutions in order to deliver more effective, credible, accountable and legitimate institutions	10.6.1 Proportion of members and voting rights of developing countries in international organizations			
10.7 Facilitate orderly, safe, regular and responsible migration and mobility of people, including through the implementation of planned and well-managed migration policies	10.7.1 Recruitment cost borne by employee as a proportion of yearly income earned in country of destination			
	10.7.2 Number of countries that have implemented well-managed migration policies			
10.a Implement the principle of special and differential treatment for developing countries, in particular least developed countries, in accordance with World Trade Organization agreements	10.a.1 Proportion of tariff lines applied to imports from least developed countries and developing countries with zero-tariff			
10.b Encourage official development assistance and financial flows, including foreign direct investment, to States where the need is greatest, in particular least developed countries, African countries, small island developing States and landlocked developing countries, in accordance with their national plans and programmes	10.b.1 Total resource flows for development, by recipient and donor countries and type of flow (e.g. official development assistance, foreign direct investment and other flows)			
10.c By 2030, reduce to less than 3 per cent the transaction costs of migrant remittances and eliminate remittance corridors with costs higher than 5 per cent	10.c.1 Remittance costs as a proportion of the amount remitted			
Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable				
11.1 By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums	11.1.1 Proportion of urban population living in slums, informal settlements or inadequate housing			
11.2 By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons	11.2.1 Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities			
11.3 By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries	11.3.1 Ratio of land consumption rate to population growth rate			
	11.3.2 Proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically			
11.4 Strengthen efforts to protect and safeguard the world's cultural and natural heritage	11.4.1 Total expenditure (public and private) per capita spent on the preservation, protection and conservation of all cultural and natural heritage, by type of heritage (cultural, natural, mixed and World Heritage Centre designation), level of government (national, regional and local/municipal), type of expenditure (operating expenditure/investment) and type of private funding (donations in kind, private non-profit sector and sponsorship)		3.1	3.1.6
11.5 By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses	11.5.1 Number of deaths, missing persons and persons affected by disaster per 100,000 people[a]			

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relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations	11.5.2 Direct disaster economic loss in relation to global GDP, including disaster damage to critical infrastructure and disruption of basic services[a]			
11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	11.6.1 Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities			
	11.6.2 Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)			
11.7 By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities	11.7.1 Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities			
	11.7.2 Proportion of persons victim of physical or sexual harassment, by sex, age, disability status and place of occurrence, in the previous 12 months			
11.a Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning	11.a.1 Proportion of population living in cities that implement urban and regional development plans integrating population projections and resource needs, by size of city			
11.b By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels	11.b.1 Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030[a]			
	11.b.2 Number of countries with national and local disaster risk reduction strategies[a]			
11.c Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials	11.c.1 Proportion of financial support to the least developed countries that is allocated to the construction and retrofitting of sustainable, resilient and resource-efficient buildings utilizing local materials			
Goal 12. Ensure sustainable consumption and production patterns				
12.1 Implement the 10-Year Framework of Programmes on Sustainable Consumption and Production Patterns, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries	12.1.1 Number of countries with sustainable consumption and production (SCP) national action plans or SCP mainstreamed as a priority or a target into national policies			
12.2 By 2030, achieve the sustainable management and efficient use of natural resources	12.2.1 Material footprint, material footprint per capita, and material footprint per GDP			
	12.2.2 Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP			
12.3 By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses	12.3.1 Global food loss index			
12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on	12.4.1 Number of parties to international multilateral environmental agreements on hazardous waste, and other chemicals that meet their commitments and obligations in transmitting information as required by each relevant agreement			

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to air, water and soil in order to minimize their adverse impacts on human health and the environment	12.4.2 Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment			
12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse	12.5.1 National recycling rate, tons of material recycled			
12.6 Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle	12.6.1 Number of companies publishing sustainability reports			
12.7 Promote public procurement practices that are sustainable, in accordance with national policies and priorities	12.7.1 Number of countries implementing sustainable public procurement policies and action plans			
12.8 By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature	12.8.1 Extent to which (i) global citizenship education and (ii) education for sustainable development (including climate change education) are mainstreamed in (a) national education policies; (b) curricula; (c) teacher education; and (d) student assessment		Note. The Green List has educational indicators that could contribute to target 12.8, but since indicator 12.8.1 focuses on formal education, they were not included here.	
12.a Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production	12.a.1 Amount of support to developing countries on research and development for sustainable consumption and production and environmentally sound technologies			
12.b Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products	12.b.1 Number of sustainable tourism strategies or policies and implemented action plans with agreed monitoring and evaluation tools		2.4, 3.3	2.4.1, 2.4.2, 3.3.1, 3.3.2
12.c Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities	12.c.1 Amount of fossil-fuel subsidies per unit of GDP (production and consumption) and as a proportion of total national expenditure on fossil fuels			
Goal 13. Take urgent action to combat climate change and its impacts[b]				
13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries	13.1.1 Number of countries with national and local disaster risk reduction strategies[a]		2.3	2.3.1
	13.1.2 Number of deaths, missing persons and persons affected by disaster per 100,000 people[a]			
13.2 Integrate climate change measures into national policies, strategies and planning	13.2.1 Number of countries that have communicated the establishment or operationalization of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production (including a national adaptation plan, nationally determined contribution, national communication, biennial update report or other)		2.3	2.3.2
13.3 Improve education, awareness-raising and human and institutional	13.3.1 Number of countries that have integrated mitigation, adaptation, impact reduction and early warning into primary, secondary and tertiary curricula			

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capacity on climate change mitigation, adaptation, impact reduction and early warning	13.3.2 Number of countries that have communicated the strengthening of institutional, systemic and individual capacity-building to implement adaptation, mitigation and technology transfer, and development actions			
13.a Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible	13.a.1 Mobilized amount of United States dollars per year starting in 2020 accountable towards the $100 billion commitment			
13.b Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities	13.b.1 Number of least developed countries and small island developing States that are receiving specialized support, and amount of support, including finance, technology and capacity-building, for mechanisms for raising capacities for effective climate change-related planning and management, including focusing on women, youth and local and marginalized communities			
Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development				
14.1 By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution	14.1.1 Index of coastal eutrophication and floating plastic debris density			
14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans	14.2.1 Proportion of national exclusive economic zones managed using ecosystem-based approaches			
14.3 Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels	14.3.1 Average marine acidity (pH) measured at agreed suite of representative sampling stations			
14.4 By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics	14.4.1 Proportion of fish stocks within biologically sustainable levels		3.6, 3.7	3.6.1, 3.6.2, 3.7.1, 3.7.2
14.5 By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information	14.5.1 Coverage of protected areas in relation to marine areas		2.1	2.1.1, 2.1.2

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14.6 By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation[c]	14.6.1 Progress by countries in the degree of implementation of international instruments aiming to combat illegal, unreported and unregulated fishing			
14.7 By 2030, increase the economic benefits to small island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism	14.7.1 Sustainable fisheries as a percentage of GDP in small island developing States, least developed countries and all countries		2.4, 3.1, 3.3	2.4.1, 2.4.2, 3.1.1, 3.1.2, 3.3.1, 3.3.2
14.a Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries	14.a.1 Proportion of total research budget allocated to research in the field of marine technology			
14.b Provide access for small-scale artisanal fishers to marine resources and markets	14.b.1 Progress by countries in the degree of application of a legal/regulatory/policy/institutional framework which recognizes and protects access rights for small-scale fisheries		1.1	1.1.2, 1.1.3, 1.1.4
14.c Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in the United Nations Convention on the Law of the Sea, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of "The future we want"	14.c.1 Number of countries making progress in ratifying, accepting and implementing through legal, policy and institutional frameworks, ocean-related instruments that implement international law, as reflected in the United Nation Convention on the Law of the Sea, for the conservation and sustainable use of the oceans and their resources		Note. Since UNCLOS is separate from the GBF and traditional PA governance systems it was excluded here.	
Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss				
15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements	15.1.1 Forest area as a proportion of total land area		2.1	2.1.1, 2.1.2
	15.1.2 Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type		2.1	2.1.1, 2.1.2
15.2 By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally	15.2.1 Progress towards sustainable forest management		3.6	3.6.1, 3.6.2
15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world	15.3.1 Proportion of land that is degraded over total land area			
15.4 By 2030, ensure the conservation of mountain ecosystems,	15.4.1 Coverage by protected areas of important sites for mountain biodiversity		2.1, 2.2	2.1.1, 2.1.2, 2.2.2, 2.2.3

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including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development	15.4.2 Mountain Green Cover Index			
15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species	15.5.1 Red List Index		2.2, 2.3, 3.7	2.2.1, 2.2.2, 2.2.3, 2.3.1, 3.7.1, 3.7.2
15.6 Promote fair and equitable sharing of the benefits arising from the utilization of genetic resources and promote appropriate access to such resources, as internationally agreed	15.6.1 Number of countries that have adopted legislative, administrative and policy frameworks to ensure fair and equitable sharing of benefits			
15.7 Take urgent action to end poaching and trafficking of protected species of flora and fauna and address both demand and supply of illegal wildlife products	15.7.1 Proportion of traded wildlife that was poached or illicitly trafficked			
15.8 By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species	15.8.1 Proportion of countries adopting relevant national legislation and adequately resourcing the prevention or control of invasive alien species			
15.9 By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts	15.9.1 Progress towards national targets established in accordance with Aichi Biodiversity Target 2 of the Strategic Plan for Biodiversity 2011-2020		2.1, 2.2, 2.4	2.1.1, 2.1.2, 2.1.4, 2.2.3, 2.4.1, 2.4.2
15.a Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems	15.a.1 Official development assistance and public expenditure on conservation and sustainable use of biodiversity and ecosystems		3.1	3.1.6
15.b Mobilize significant resources from all sources and at all levels to finance sustainable forest management and provide adequate incentives to developing countries to advance such management, including for conservation and reforestation	15.b.1 Official development assistance and public expenditure on conservation and sustainable use of biodiversity and ecosystems		3.1	3.1.6
15.c Enhance global support for efforts to combat poaching and trafficking of protected species, including by increasing the capacity of local communities to pursue sustainable livelihood opportunities	15.c.1 Proportion of traded wildlife that was poached or illicitly trafficked			
Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels				
16.1 Significantly reduce all forms of violence and related death rates everywhere	16.1.1 Number of victims of intentional homicide per 100,000 population, by sex and age			
	16.1.2 Conflict-related deaths per 100,000 population, by sex, age and cause			
	16.1.3 Proportion of population subjected to physical, psychological or sexual violence in the previous 12 months			
	16.1.4 Proportion of population that feel safe walking alone around the area they live			
16.2 End abuse, exploitation, trafficking and all forms of violence against and torture of children	16.2.1 Proportion of children aged 1-17 years who experienced any physical punishment and/or psychological aggression by caregivers in the past month			
	16.2.2 Number of victims of human trafficking per 100,000 population, by sex, age and form of exploitation			

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	16.2.3 Proportion of young women and men aged 18-29 years who experienced sexual violence by age 18			
16.3 Promote the rule of law at the national and international levels and ensure equal access to justice for all	16.3.1 Proportion of victims of violence in the previous 12 months who reported their victimization to competent authorities or other officially recognized conflict resolution mechanisms			
	16.3.2 Unsentenced detainees as a proportion of overall prison population			
16.4 By 2030, significantly reduce illicit financial and arms flows, strengthen the recovery and return of stolen assets and combat all forms of organized crime	16.4.1 Total value of inward and outward illicit financial flows (in current United States dollars)			
	16.4.2 Proportion of seized small arms and light weapons that are recorded and traced, in accordance with international standards and legal instruments			
16.5 Substantially reduce corruption and bribery in all their forms	16.5.1 Proportion of persons who had at least one contact with a public official and who paid a bribe to a public official, or were asked for a bribe by those public officials, during the previous 12 months			
	16.5.2 Proportion of businesses that had at least one contact with a public official and that paid a bribe to a public official, or were asked for a bribe by those public officials during the previous 12 months			
16.6 Develop effective, accountable and transparent institutions at all levels	16.6.1 Primary government expenditures as a proportion of original approved budget, by sector (or by budget codes or similar)		3.1	3.1.6
	16.6.2 Proportion of the population satisfied with their last experience of public services		1.1, 1.2	1.1.2, 1.1.3, 1.1.4, 1.2.3, 1.2.4
16.7 Ensure responsive, inclusive, participatory and representative decision-making at all levels	16.7.1 Proportions of positions (by sex, age, persons with disabilities and population groups) in public institutions (national and local legislatures, public service, and judiciary) compared to national distributions		1.1	1.1.2, 1.1.3, 1.1.4, 1.1.5, 1.1.6
	16.7.2 Proportion of population who believe decision-making is inclusive and responsive, by sex, age, disability and population group		1.2	1.2.1, 1.2.2, 1.2.3, 1.2.4
16.8 Broaden and strengthen the participation of developing countries in the institutions of global governance	16.8.1 Proportion of members and voting rights of developing countries in international organizations			
16.9 By 2030, provide legal identity for all, including birth registration	16.9.1 Proportion of children under 5 years of age whose births have been registered with a civil authority, by age			
16.10 Ensure public access to information and protect fundamental freedoms, in accordance with national legislation and international agreements	16.10.1 Number of verified cases of killing, kidnapping, enforced disappearance, arbitrary detention and torture of journalists, associated media personnel, trade unionists and human rights advocates in the previous 12 months			
	16.10.2 Number of countries that adopt and implement constitutional, statutory and/or policy guarantees for public access to information		1.2	1.2.1, 1.2.2, 1.2.3, 1.2.4

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16.a Strengthen relevant national institutions, including through international cooperation, for building capacity at all levels, in particular in developing countries, to prevent violence and combat terrorism and crime	16.a.1 Existence of independent national human rights institutions in compliance with the Paris Principles			
16.b Promote and enforce non-discriminatory laws and policies for sustainable development	16.b.1 Proportion of population reporting having personally felt discriminated against or harassed in the previous 12 months on the basis of a ground of discrimination prohibited under international human rights law			
Goal 17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development				
Finance				
17.1 Strengthen domestic resource mobilization, including through international support to developing countries, to improve domestic capacity for tax and other revenue collection	17.1.1 Total government revenue as a proportion of GDP, by source			
	17.1.2 Proportion of domestic budget funded by domestic taxes			
17.2 Developed countries to implement fully their official development assistance commitments, including the commitment by many developed countries to achieve the target of 0.7 per cent of gross national income for official development assistance (ODA/GNI) to developing countries and 0.15 to 0.20 per cent of ODA/GNI to least developed countries; ODA providers are encouraged to consider setting a target to provide at least 0.20 per cent of ODA/GNI to least developed countries	17.2.1 Net official development assistance, total and to least developed countries, as a proportion of the Organization for Economic Cooperation and Development (OECD) Development Assistance Committee donors' gross national income (GNI)			
17.3 Mobilize additional financial resources for developing countries from multiple sources	17.3.1 Foreign direct investments (FDI), official development assistance and South-South Cooperation as a proportion of total domestic budget			
	17.3.2 Volume of remittances (in United States dollars) as a proportion of total GDP			
17.4 Assist developing countries in attaining long-term debt sustainability through coordinated policies aimed at fostering debt financing, debt relief and debt restructuring, as appropriate, and address the external debt of highly indebted poor countries to reduce debt distress	17.4.1 Debt service as a proportion of exports of goods and services			
17.5 Adopt and implement investment promotion regimes for least developed countries	17.5.1 Number of countries that adopt and implement investment promotion regimes for least developed countries			
Technology				
17.6 Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge-sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level, and through a global technology facilitation mechanism	17.6.1 Number of science and/or technology cooperation agreements and programmes between countries, by type of cooperation			
	17.6.2 Fixed Internet broadband subscriptions per 100 inhabitants, by speed			

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17.7 Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed	17.7.1 Total amount of approved funding for developing countries to promote the development, transfer, dissemination and diffusion of environmentally sound technologies			
17.8 Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technology, in particular information and communications technology	17.8.1 Proportion of individuals using the Internet			
Capacity-building				
17.9 Enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans to implement all the Sustainable Development Goals, including through North-South, South-South and triangular cooperation	17.9.1 Dollar value of financial and technical assistance (including through North-South, South-South and triangular cooperation) committed to developing countries			
Trade				
17.10 Promote a universal, rules-based, open, non-discriminatory and equitable multilateral trading system under the World Trade Organization, including through the conclusion of negotiations under its Doha Development Agenda	17.10.1 Worldwide weighted tariff-average			
17.11 Significantly increase the exports of developing countries, in particular with a view to doubling the least developed countries' share of global exports by 2020	17.11.1 Developing countries' and least developed countries' share of global exports			
17.12 Realize timely implementation of duty-free and quota-free market access on a lasting basis for all least developed countries, consistent with World Trade Organization decisions, including by ensuring that preferential rules of origin applicable to imports from least developed countries are transparent and simple, and contribute to facilitating market access	17.12.1 Average tariffs faced by developing countries, least developed countries and small island developing States			
Systemic issues				
Policy and institutional coherence				
17.13 Enhance global macroeconomic stability, including through policy coordination and policy coherence	17.13.1 Macroeconomic Dashboard			
17.14 Enhance policy coherence for sustainable development	17.14.1 Number of countries with mechanisms in place to enhance policy coherence of sustainable development			
17.15 Respect each country's policy space and leadership to establish and implement policies for poverty eradication and sustainable development	17.15.1 Extent of use of country-owned results frameworks and planning tools by providers of development cooperation			
Multi-stakeholder partnerships				

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17.16 Enhance the Global Partnership for Sustainable Development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the Sustainable Development Goals in all countries, in particular developing countries	17.16.1 Number of countries reporting progress in multi-stakeholder development effectiveness monitoring frameworks that support the achievement of the sustainable development goals			
17.17 Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships	17.17.1 Amount of United States dollars committed to public-private and civil society partnerships			
Data, monitoring and accountability				
17.18 By 2020, enhance capacity-building support to developing countries, including for least developed countries and small island developing States, to increase significantly the availability of high-quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts	17.18.1 Proportion of sustainable development indicators produced at the national level with full disaggregation when relevant to the target, in accordance with the Fundamental Principles of Official Statistics			
	17.18.2 Number of countries that have national statistical legislation that complies with the Fundamental Principles of Official Statistics			
	17.18.3 Number of countries with a national statistical plan that is fully funded and under implementation, by source of funding			
17.19 By 2030, build on existing initiatives to develop measurements of progress on sustainable development that complement gross domestic product, and support statistical capacity-building in developing countries	17.19.1 Dollar value of all resources made available to strengthen statistical capacity in developing countries			
	17.19.2 Proportion of countries that (a) have conducted at least one population and housing census in the last 10 years; and (b) have achieved 100 per cent birth registration and 80 per cent death registration			
(E/CN.3/2016/2/Rev.1) and agreed upon, as a practical starting point at the 47th session of the United Nations Statistical Commision held in March				
Assembly (resolution 69/284) is developing a set of indicators to measure global progress in the implementation of the Sendai Framework. These				
negotiating the global response to climate change.				
[c] Taking into account ongoing World Trade Organization negotiations, the Doha Development Agenda and the Hong Kong ministerial mandate.				