# Mainstreaming Biodiversity Targets into Sectoral Policies and Plans: A Review of Scientific Research

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*Hens Runhaar[a,b,1], Fabian Pröbstl[c], Felician Heim[c], Elsa Cardona Santos[c], Joachim Claudet[d], Lyda Dik[b], Guilherme de Queiroz-Stein[e], Agnes Zolyomi[f], and Yves Zinngrebe[c]*

[a] Copernicus Institute of Sustainable Development, Utrecht University, Utrecht, the Netherlands
[b] Forest and Nature Conservation Policy Group, Wageningen University and Research, Wageningen, the Netherlands
[c] Department of Conservation Biology and Social-Ecological Systems, Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany
[d] National Center for Scientific Research, PSL Université Paris, CRIOBE, CNRS-EPHE-UPVD, Paris, France
[e] Institute of Political Science, University of Münster, Münster, Germany
[f] Centre for Agroecology, Water and Resilience (CAWR), Coventry University, Coventry, United Kingdom

**Abstract**

The integration or mainstreaming of biodiversity targets in sectoral policies and plans (BPI) is considered necessary for bending the curve of biodiversity loss. Scientific research on the actual performance of BPI is rather recent and fragmented. In this paper, based on a coding scheme, we systematically analyse international empirical studies on BPI published in 43 international peer-reviewed journal papers. We show that, so far, overall levels of BPI are low, reflected on too abstract targets, add-on biodiversity policies not targeting the driving forces of biodiversity loss, and insufficient resources made available to pursue biodiversity recovery. Joint planning processes, the revision of policies for consistent and coherent incentives, and adaptive learning are identified as central factors for improving BPI, but considerable barriers in these areas undermine progress in BPI. A change in institutional settings seems necessary to provide more favourable conditions for BPI, including the assignment of less voluntary responsibilities for biodiversity recovery.

*Key words:* policy integration, governance, barriers, enablers, nature.

## 1. Introduction

The alarming rates of biodiversity loss worldwide have made clear that the classical way of governing biodiversity recovery based on protected areas and programmes for the protection of endangered species does not suffice. Effective responses to halt biodiversity loss will have to address direct and indirect drivers which are typically governed by actors beyond the environmental sector (IPBES, 2019). Direct drivers include changes in land and sea use, exploitation, climate change, pollution, and invasion of alien species, whereas indirect drivers refer to societal values and behaviours, production and consumption patterns, human population dynamics, trade, technological innovations, and multi-level governance systems (IPBES, 2019). The Convention on Biological Diversity (CBD) has mandated its parties to develop national strategies, plans or programmes to address these direct and indirect drivers by means of the integration of *"the conservation and sustainable use of biological diversity into relevant sectoral and cross-sectoral plans programmes and policies"* (CBD, n.d.). The Kunming-Montreal Global Biodiversity Framework (GBF) has now strengthened the mandate to mainstream biodiversity across policies, plans and monitoring processes as well as across all levels of government (CBD 2022a, target 14). It furthermore calls for action on mitigating direct drivers, as for instance in a sustainable management of agriculture, aquaculture, fisheries, and forestry (target 10), as well as indirect drivers such as the business reporting (target 15), sustainable consumption (target 16), or by phasing out harmful subsidies and incentives (target 18).

[1] Corresponding author.

Yet, scientific studies that have evaluated empirical cases of biodiversity integration or mainstreaming indicate that this strategy does not live up to its expectations. For instance, Karlsson-Vinkhuyzen et al., (2018) observe that for 3 cases of biodiversity integration (i.e., the Marine Stewardship Council label for sustainable fisheries, certified palm oil, and foreign direct investment in land), *"efforts can be characterized mostly to be limited as they are at the level of harmonization (reducing contradictory incentives) and coordination between biodiversity and ecosystem services and economic priorities with a low degree of implementation"* (Karlsson-Vinkhuyzen et al., 2018: p. 136). Zinngrebe et al. (2022) observe that regarding the integration of biodiversity considerations in agricultural policies and practices worldwide, *"overall very modest advances"* have been made (Zinngrebe et al., 2022: p. 278). Finally, Bogers (2023) observes that among international organisations, the biodiversity-related UN Sustainable Development Goals (i.e., 'oceans' - SDG 14 - and 'land' - SDG 15) have been prioritised the least of all SDGs. This limited progress justifies scientific research to better understand integration processes and their key barriers and enablers, similar to earlier scientific work on Climate Policy Integration (Gungor and Sari 2022, Hidalgo et al. 2021, Biesbroek, 2021), Environmental Policy Integration more generally (Persson and Runhaar, 2018), and on the integration of Sustainable Development Goals in policy making (Biermann et al., 2022). Such research is necessary to provide guidance for the further development of biodiversity integration or mainstreaming and its monitoring, supporting the *"long-term-strategic approach to mainstreaming"* (CBD, 2022b) as well as the monitoring framework (CBD, 2023).

This paper synthesises findings from scientific research worldwide, including the insights from the *Earth System Governance* special issue on 'The Governance of Biodiversity Recovery: From Global Targets to Sectoral Action'. We do so by systematically coding and analysing empirical studies published in international, peer-reviewed journals. As our central concept, we employ 'Biodiversity Policy Integration' (BPI) because we conceptually and methodologically draw from literature in this domain. However, we consider BPI synonymous with biodiversity mainstreaming.

The questions that we address are the following:

1. How have biodiversity targets been integrated in efforts to promote biodiversity, from policy formulation to implementation?
2. What enabling and hindering factors and processes explain the results of BPI efforts in terms of their (potential) contribution to biodiversity protection and recovery?
3. What structural conditions influence the scope for BPI, and what explains the emergence or absence of these conditions?

In the next Section, we present our analytical framework, which builds on scientific advances on BPI. We then discuss our methodology in Section 3. After presenting our findings in Section 4, we formulate an outlook for a future research agenda in Section 5.

## 2. Analytical framework

### *2.1. Biodiversity and biodiversity targets*

The CBD defines biodiversity as *"the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems"* (CBD, n.d.). Biodiversity targets in policies and plans can be formulated in many ways, ranging from goals for protecting specific species (e.g., honeybees) or habitats (e.g., deforestation in the Amazon), to reducing critical pressures on biodiversity (e.g., pesticide use in agriculture).

### *2.2. BPI and its implementation*

BPI refers to *"the consideration of biodiversity in all sectors and levels of policymaking and implementation"* (Zinngrebe et al., 2022: 265) whereby policy-making refers to *"policies, strategies and practices of key public and private actors that impact or rely on biodiversity"* (Huntley, 2014: 1). It is important to note that both practitioners and researchers differ in how much weight biodiversity targets should receive in sectoral policies (see also Runhaar et al., 2020). This is not only reflected in its operationalisation (see below in Section 2.3) but also relates to whether equity and justice are taken into the equation (e.g., Huntley, 2014)

In order to stimulate and facilitate BPI processes, there are specific cross-cutting instruments, such as 'no net loss of biodiversity' regulations or Environmental Impact Assessments (EIA) that incorporate biodiversity in decision-making on sectoral policies or licensing procedures; voluntary measures to conserve biodiversity, such as standards, whether or not they are part of their Corporate Social Responsibility policies; financial incentive schemes such as Payments for Ecosystem Services, taxes, green budgeting and green procurement; or communicative instruments, such as eco-labels and 'natural capital accounting' (Chandra and Idrisova, 2011; Quétier et al., 2014; Bidaud et al., 2015; Tayleur et al., 2017; Huge et al., 2020a; Swensson and Tartanac, 2020; Zinngrebe et al., 2022; and Van der Jagt et al., 2023). Next to these instruments, which usually classify as "add-ons" to dominant sectoral policies and plans (Westerink et al., 2015), sectoral practices have been developed that fully incorporate biodiversity, such as eco-engineering, nature-based solutions, building with nature, and agroecology (Persson et al., 2018; Tittonell et al., 2020).

### *2.3. Measuring BPI*

In a recent publication on BPI (Zinngrebe et al., 2022), which builds on earlier and wider literature on 'Environmental Policy Integration' (e.g., Kivimaa and Mickwitz, 2006), the following indicators are proposed to measure BPI at the level of *outputs* (ambitions in policy documents or other public statements and the implementation of concrete measures) and *outcomes* (the resulting changes in practices at sector-level):

- *Inclusion*: the extent to which biodiversity targets are specified, as well as the scope of the intervention (large part of the sector or only a small part) (Kivimaa and Mickwitz, 2006; Uittenbroek et al., 2013; Runhaar et al., 2017; Zinngrebe et al., 2022).
- *Operationalisation*: whether specific practices and behavioural changes of target groups needed to realise the biodiversity targets are specified; the extent to which policy instruments (see above) are implemented to achieve the above targets; and the implementation of monitoring schemes

to measure progress in achieving these targets, as well as follow-up procedures to take action in case targets are not achieved (Kivimaa and Mickwitz, 2006; Uittenbroek et al., 2013; Runhaar et al., 2017; Grimm, 2020; Zinngrebe et al., 2022).

- *Coherence:* the extent to which the intervention addresses the driving forces of biodiversity loss within the sector at issue, and the extent to which policies that regulate driving forces are adapted to enhance biodiversity conservation and recovery. In agricultural policies at EU-level and in The Netherlands, for instance, this is not the case. Here, conservation policies are separate, 'add-on' interventions next to mainstream policy that reinforces or at least maintains agricultural intensification, which is a main driver of biodiversity loss (Kivimaa and Mickwitz, 2006; Uittenbroek et al., 2013; Runhaar et al., 2017; Zinngrebe et al., 2022).
- *Capacity*: the provision of resources (money, people, knowledge, organisational structures, etc.) to ensure the implementation of instruments identified in the "operationalisation" dimension (see e.g., Kivimaa and Mickwitz, 2006; Uittenbroek et al., 2013; Bizikova et al., 2015; Zinngrebe et al., 2022).
- *Weighting:* the political priority of biodiversity targets and policies in relation to other sectoral targets and policies. In this respect, Lafferty and Hovden (2003) distinguish between 'coordination' (preventing - to some extent - contradictions between sectoral and environmental targets), 'harmonisation' (creating synergies between sectoral and environmental targets), and 'prioritisation' (favouring environmental targets) ( see also Karlsson-Vinkhuyzen et al., 2018 and Persson and Runhaar, 2018). In this paper, we take a pragmatic way of measuring weighting by looking at the (re)allocation of funding of activities that support biodiversity versus activities that relate to the driving forces of biodiversity loss (such as promoting agricultural intensification).

### *2.4. Enabling and hindering factors*

A first set of independent variables consist of the following enablers and barriers (based on Zinngrebe et al., 2022). These criteria analyse how collaborative processes have been applied to improve the level of BPI within a certain setting:

- *Joint planning:* co-developing a joint vision, integrating the world views and interests of different relevant stakeholders, defining a clear mandate for relevant stakeholders, inducing ownership of stakeholders.
- *Consistent policy revision:* policy makers across political sectors engage in linking and revising their policies to phase out harmful subsidies and empower the support for biodiversity policies.
- *Adaptive learning:* actors in the reported cases engage in joint evaluation and review processes that strengthen accountability and realign policies.

### *2.5. Structural conditions*

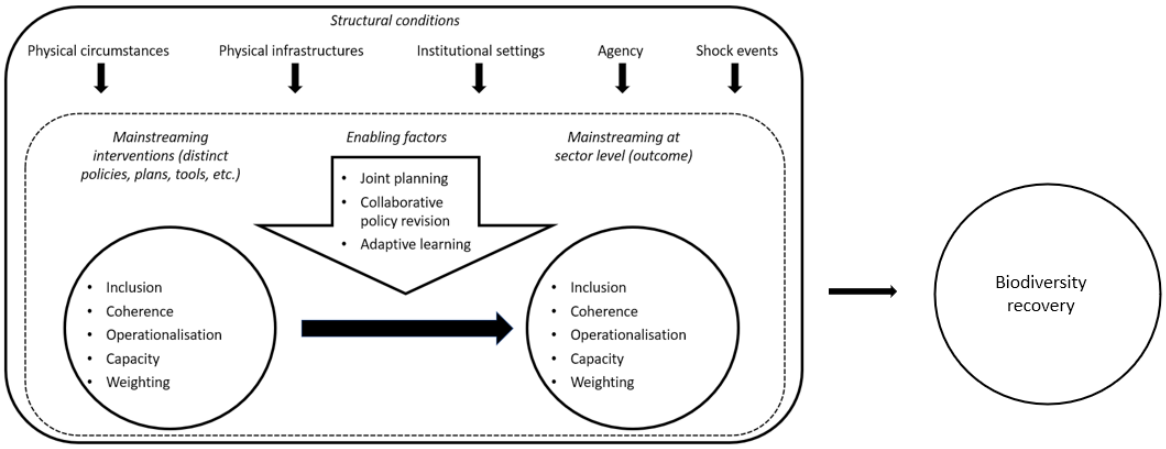
A second set of independent variables explains, at a more structural level, the scope for promoting of BPI. These factors analyse characteristics and dynamics in the political arena that can facilitate or block policy changes that are needed for BPI. For the analysis, we build on the work of Hegger et al. (2020), which provides explanations for stability and change in modes of governance:

- *Physical circumstances*: e.g., gradual changes in ecosystems with direct consequences for policy sectors, such as reduced soil fertility due to intensive farming practices, threatening food security.

- *Physical infrastructures*: e.g., investments in grey infrastructures for sewage or transport in cities, which are fixed for the medium to long term and that hinder the allocation of funds towards green infrastructures or urban 'nature-based solutions'.
- *Institutional settings*: institutions are the *"rules, norms and strategies adopted by individuals operating within and across organisations"* (Ostrom, 2007, in Hegger et al., 2020: 5) and form "*recurrent patterned arrangements, which limit the choices and opportunities available, as opposed to agency that is the capacity of individuals to act independently and to make their own free choices*" (Hegger et al. 2020: 5). Institutions that may provide or limit the scope for BPI include mechanisms to hold specific actors accountable for biodiversity action; the legal basis of EIA legislation (i.e., mandatory of voluntary); a culture of collaboration between public and private actors within a policy sector ('social capital'); the regular evaluation and reconsideration of policies and their outcomes and impacts, which provides space for the consideration of biodiversity targets ('reflexivity' or 'adaptive learning'); and the flexibility or rigidity ('lock-in') of institutions.
- *Discourse*: e.g., the framing of biodiversity recovery as a cost rather than as a benefit, competing discourses that inhibit joint action, etc.
- *Agency*: political or societal pressure, specific actors using their power (or building coalitions to mobilise power) to take biodiversity action (including the deliberate framing of biodiversity recovery as key to achieving sectoral targets).
- *Shock events*: sudden and unexpected events, originating either within or outside a policy domain that provide windows of opportunity for change. An example is the 2017 paper reporting on 75% loss in insects in 30 years in German nature reserve areas (Hallmann et al., 2017).

Figure 1 visualises the overall analytical framework.

*Figure 1: Key factors affecting Biodiversity Policy Integration*




Note: In this paper, we focus on Biodiversity Policy Integration at output and outcome level. The eventual impacts on biodiversity recovery are excluded as this requires ecological research (Karlsson-Vinkhuyzen et al., 2018).

## 3. Method

### *3.1. Research strategy: literature review*

We synthesised findings from empirical scientific research published in academic papers to ensure the quality of the knowledge basis. Next to the 8 papers that make up the ESG Special Issue on *The Governance of Biodiversity Recovery: From Global Targets to Sectoral Action*, we conducted a literature search in Web of Science (("biodiversity" OR "biological diversity") AND ("policy integration" OR "policy coherence" OR "mainstreaming" in the title)). Adding the 8 special issue papers and 37 papers from the structured review resulted in 43 papers, as 2 papers appeared in both structural search and special issue. 1 paper presented 3 cases of BPI that could be coded separately (for a few other papers, it was not possible to identify and code distinct cases). Thus, in total, we identified 46 BPI cases in our sample.

### *3.2. Coding and analysis*

The first and last authors of this paper developed a coding scheme for measuring BPI (see section 2.3) and for coding the enabling factors (2.4) and the structural variables (2.5). We built on categories from previous studies (particularly Runhaar et al., 2020 and Zinngrebe et al., 2022). For BPI we developed scales to enable the coding of the papers. The first variable related to BPI as output and outcome was coded both quantitatively and qualitatively. The enabling factors and structural variables were coded qualitatively into the predefined categories (see Sections 2.4 and 2.5). Within each category statements were openly coded to do justice to the variety of ways in which they manifest themselves. Codes were then grouped into aspect categories as listed in Tables 1 and 2.

The coding scheme was applied to a sample of papers by the first and last authors of this paper to test the coding scheme and to verify the reliability and practical applicability of the coding. The 43 papers were then coded by the 6 co-authors of this paper (all contributors to the Special Issue), who were being instructed via a guideline (see Annex 3) including 2 examples of coded papers. All codings were checked on consistency, which led to follow-up requests to the co-authors to clarify their coding and indicate a specific coding within the predefined scale. The resulting data was subsequently analysed, shared, and discussed with all co-authors.

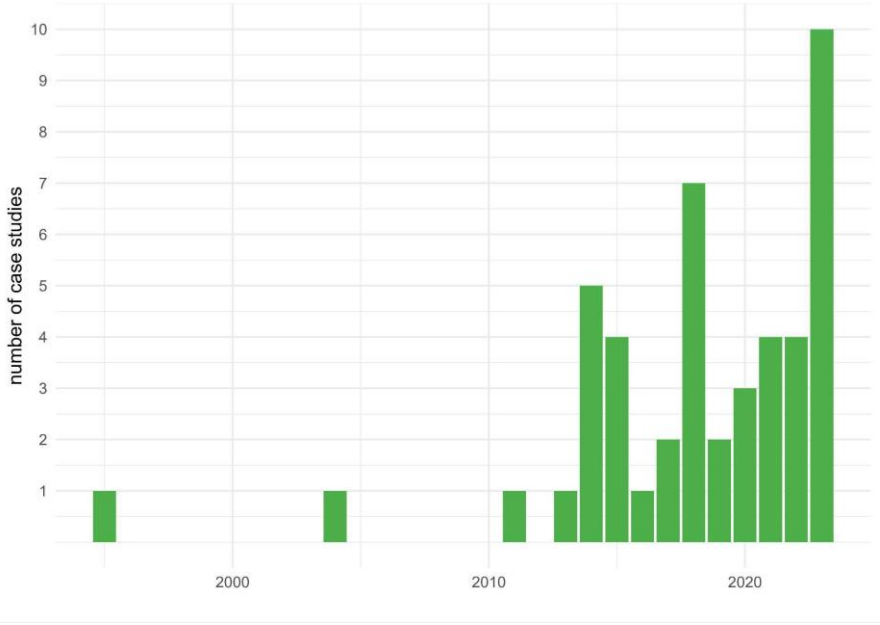
The data were based on what we could derive from the papers; no additional data was collected (e.g., about missing variables or to update the level of BPI in a certain sector and geographical context).

## 4. Results

### *4.1. General observations*

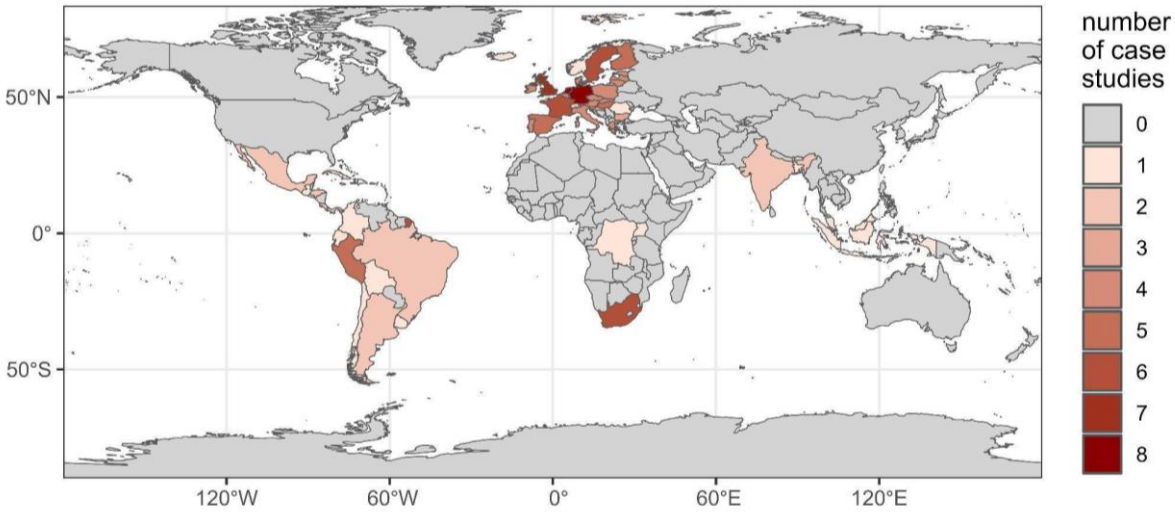
Figure 2 shows that most papers on BPI have been published over the last decade. This is consistent with authors who stated that until 2014, little research has been conducted on this subject (Huntley, 2014; Sarkki et al., 2015). A substantial part of the papers that we coded does not provide empirical evidence regarding our variables (see Tables 1 and 2). This does not necessarily mean that all BPI practices analysed in the papers are unclear or incomplete in these respects, it is rather related to the research scope presented in these papers. However, a main conclusion is that relatively little scientific research has assessed BPI in a comprehensive way, and that our understanding of the factors that contribute to BPI is rather fragmented.

*Figure 2: Number of case studies on Biodiversity Policy Integration per year*




Geographically, the majority of papers focus on analysing Europe, though other regions are also examined (see Figure 3). The geographical distribution of BPI does not necessarily reflect the intensity of BPI practices but may be indicative. In terms of sectors at issue in our sample of papers, forestry, agriculture, fisheries, and development are among the most often analysed ones (Annex 4). This is not surprising given their large impact on biodiversity (CBD, 2022a; WWF, 2022). There are also several papers that address a (large) number of sectors, e.g., in the context of the National Biodiversity Strategies and Action Plans (NBSAPs) that were developed to work towards the CBD targets.

*Figure 3: Geographical distribution of case studies on Biodiversity Policy Integration*




Note: 3 case studies did not specify a geographical focus whereas 10 case studies had an international or global focus.

*Table 1: Evidence about Biodiversity Policy Integration in the sample of papers (NB: salient aspects refer to findings regarding the indicators in general, regardless of the scales)*

| Indicators | Scale | Score | Salient aspects |
|---|---|---|---|
| *Inclusion* | | | |
| Specification of biodiversity targets | ● Specified (SMART)<br>● Mentioned (qualitatively)<br>● Unclear or no information | 13%<br>41%<br>46% | ● Targets refer to international or national targets<br>● Reference to specific biodiversity components or related aspects (e.g., traditional knowledge)<br>● General reference emerging from participatory process<br>● Other SMARTness aspects not covered |
| Sectoral coverage | ● Substantial part sector addressed<br>● Small part sector addressed<br>● Unclear or no information | 26%<br>7%<br>67% | ● Specifying major sector policies that shall consider biodiversity<br>● Targeting biodiversity related sub-policy<br>● General reference to sector policy<br>● Sustainable international finance and business |
| *Operationalisation* | | | |
| Behavioural outcome specified | ● Desired behavioural changes of sectoral actors specified<br>● Desired behavioural changes mentioned but vaguely<br>● Unclear or no information | 48%<br>13%<br>39% | ● Changing management practices<br>● Change governmental regulation<br>● Changing governmental routines<br>● Increasing responsibility, precaution, and awareness<br>● Mitigation measures to improve biodiversity outcomes<br>● Minimising waste<br>● Changing scientific practice<br>● No outcome specified |
| Policy instruments | ● Implemented<br>● Mentioned but not implemented<br>● Unclear or not mentioned | 41%<br>28%<br>31% | ● Planning instruments (e.g., NBSAPs)<br>● Economic instruments (e.g., Payments for Ecosystem Services)<br>● Monitoring schemes and assessments (e.g., EIAs, SEAs)<br>● Legal instruments (e.g., contractual agreements)<br>● Information-based instruments (e.g., certification)<br>● Conservation concepts |
| Monitoring and follow-up | ● Implemented<br>● Mentioned but not implemented<br>● Unclear or not mentioned | 20%<br>17%<br>63% | ● Key element for bridging the implementation-gap<br>● Provides argumentation aid for resources<br>● Aichi Targets and NBSAPs supported establishment of monitoring mechanisms<br>● Little information about responsible actors and bindingness |
| *Coherence* | | | |
| Addressing direct and indirect drivers of biodiversity loss | ● Yes, both<br>● Only driving forces addressed (not the policies)<br>● Unclear or not mentioned | 36%<br>15%<br>49% | • Addressed indirect drivers (e.g., underlying economic paradigm, perverse incentives, social justice, perception of forestry, fishing policies, agriculture policies, tourism, poverty, high density of population, corruption)<br>• Direct drivers (e.g., ocean pollution, acidification, global warming, intensification, invasive species, habitat loss, illegal wildlife extraction and trade, altered atmospheric chemistry) |
| Coherence of biodiversity targets with sector policies | ● All policies adjusted to support biodiversity<br>● Support for biodiversity exists next to support for intensified production and other driving forces<br>● Unclear or not mentioned | 9%<br>41%<br>50% | • Coherent policy design (e.g., agri-environmental schemes on landscape scale)<br>• Parallel support for biodiversity and driving forces (e.g., agroecology in parallel with industrialised agriculture; matching of ecological and social considerations in farmer's contracts; forestry between multifunctionality and timber production; problematic stringency of Programme for the Endorsement of Forest Certification standards across countries) |
| *Capacity* | | | |
| Financial and human capital | ● Resources made available and reasonably sufficient to achieve biodiversity targets | 24%<br>46% | ● Lacking institutional interplay, vertical coordination, and goal misalignment preventing resource mobilisation<br>● Limited funding and political will as barriers |

| Indicators | Scale | Score | Salient aspects |
|---|---|---|---|
| | ● No resources made available or doubtful whether sufficient<br>● Unclear or not mentioned | 30% | ● Traditional knowledge and awareness as levers<br>● Monitoring data for raising awareness and mobilising funds<br>● Transfer of funds from other sources (e.g., climate funds)<br>● Importance of providing long-lasting incentives<br>● Mobilisation of resources by international agreements |
| *Weighting* | | | |
| Financial allocation | ● Large shares of funding of activities supporting biodiversity<br>● Funding for activities supporting biodiversity and driving forces co-exist<br>● Large shares of funding go to driving forces<br>● Unclear or not mentioned | 11%<br>15%<br>15%<br>59% | • Funding provided for biodiversity specific policies<br>• Missing funds for considering biodiversity in integrative policies<br>• Privately financed implementation<br>• Priority for potential biodiversity threats and harmful subsidies<br>• Low effectiveness in the implementation of funding<br>• Nature as resource for economic development and growth |
| Decision making | ● Project approbation (e.g., EIAs, production, infrastructure) is prioritising biodiversity impacts as factors for approving a project<br>● Biodiversity is a valid criterion, but no clear prioritisation required, and/or compensation of biodiversity effects required<br>● Unclear or not mentioned | 7%<br>35%<br>58% | • Resistance by vested interests and dominance of sector policies<br>• Low ambition for sector targets in biodiversity strategies<br>• Prioritising certain knowledge systems<br>• Low consideration in integrated land-use planning<br>• No biodiversity assessment in approval of foreign direct investment |

Below, we present the main findings from our literature review, organised along the three research questions of our paper.

### *4.2. Research question 1: How have biodiversity targets been mainstreamed in efforts to promote biodiversity, from policy formulation to implementation?*

On average, evidence is provided in over half of the cases regarding the extent and ways in which biodiversity targets have been mainstreamed in terms of inclusion, operationalisation, coherence, capacity, and weighting (see Table 1). Below, we summarise our main observations and findings.

**Inclusion**

*Indicator 1: Specification of biodiversity targets*

In surprisingly few cases (6 or 13% of all cases, see Table 1), biodiversity targets are formulated in a SMART (Specific, Measurable, Actionable, Responsible, Time-bound) way. In most cases where biodiversity targets are mentioned, this is done in a general way, for instance by referring to national or international targets such as the Aichi targets (Wilson 2023, Fajardo et al. 2021, Bisht et al. 2020, Garraud et al. 2023), but without specifying these for the sector(s) at issue. Moreover, despite generic commitments, sector policies were found to miss specific perspectives on biodiversity, e.g., is blind to trees on farms as central habitat structures in agricultural landscapes (Rode et al. 2023). Even National Biodiversity Strategies and Action Plans ((NBSAP) focus on add-on biodiversity efforts and compensating impacts rather than setting biodiversity targets for sector activities (e.g., Pröbstl et al., 2023, this issue). In that context, Whitehorn et al. (2019) conclude that NBSAPs are weak policy instruments due to a lack of ownership, unclarity about what mainstreaming means, and a lack of coordination mechanisms and liability.

Better examples of the inclusion of biodiversity targets in sectoral policies, in this case agriculture, where Agri-Environment Schemes (AES) in the Netherlands specify conservation measures for 68 species of the EU Birds and Habitats Directive (Dik et al. (2023, this issue). As further examples, the UK environmental policies aim for 10% biodiversity improvements measured with a "standardised biodiversity matrix" (Wilson 2023), or uses OECD biodiversity markers (Börken et al. 2022). The example of fishery certification specifies extraction rates per area for fishing activities (Garraud et al. 2023). In many documented experiences however, biodiversity and ecosystem services are generic goals that are negotiated in participatory processes (Zolyomi et al. 2023) or cooperation with the global South (Huge et al. 2020b).

*Indicator 2: Share of the sector addressed by the BPI intervention*
About a quarter of the cases (12 in total) are about BPI efforts that target a substantial part of the sector involved. As an example, in 2023, the UK government has proposed an Environmental Bill that, for all new spatial developments, requires a *"mandatory biodiversity net gain requirement of at least 10% (...), using a biodiversity metric as a standardized measurement tool"* Wilson (2023, p. 555). Yet, in a majority of the cases, biodiversity is only mentioned in general terms in the sector policy, for instance in forestry policies in Germany, France, Netherlands, and Sweden (Sotirov and Storch 2018), or in mining in South Africa (Holness et al. 2018).

In a few cases, it becomes clear what share of a sector is addressed by BPI interventions. For instance, Dutch AES do not apply to all agricultural landscapes but only to those areas that are interesting from an ecological perspective and thereby limit the number of farmers that are eligible (Runhaar et al., 2017). Finally, there are specific interventions that have the potential to integrate specific biodiversity measures in a large part of the sector involved, such as the Environmental Impacts Assessments or the EU's Common Agricultural Policy (Simoncini et al., 2019).

**Operationalisation**
*Indicator 1: Behavioural outcomes specified*
In only 21 cases it is specified how an intervention is supposed to change social behaviour to meet biodiversity targets, while 5 mention desired outcomes vaguely. In 14 cases no outcomes are specified. The change in management practices is a central behavioural change, visible in very different contexts, for instance a change in fishery management (Friedmann 2018) or the operationalisation of ecosystem resilience in peri-urban spaces (Sevianu et al., 2021). A change of governmental regulations is mentioned in 5 cases, referring for instance to changes in subsidy schemes (Alblas and Van Zeben, 2023, this issue), price premiums through a certification of biodiversity friendly production (Garraud et al., 2023), or the formalised recognition of ecosystem services (Zolyomi et al., 2023). Changing governmental routines (4 cases) refers for instance to the consideration of different biodiversity related values in land-use decisions and the requirement of compromises for possible solutions, as found in Durban, South Africa (Shih and Mabon, 2019). In 4 other cases, a change in responsibility or the consideration of precaution and awareness is identified, as they for instance *"produce a shared sense of responsibility among diverse stakeholders, empower a proactive and prenetative response to biodiversity loss and help businesses and investors manage risk and opportunity"* (Milner-Gulland et al. 2021, p.76).

*Indicator 2: Policy instruments to work towards the targets*

In 18 cases, policy instruments reported to have been implemented, while in the rest of the cases they are only mentioned or it is unclear whether policy instruments have been identified and/or implemented. Categorising the different policy instruments reveals that planning instruments such as NBSAPs seem to dominate as tools for achieving BPI (13 cases). In addition, economic instruments are mentioned in 8 cases and monitoring schemes or assessments in 7 cases. Smith (2004) mentions EIAs, SEAs, environmental auditing, and integrated catchment management as 'tools' to promote the integration of social, economic, and environmental factors into decision-making. For the global forestry sector, Karlsson-Vinkhuyzen et al. (2017) emphasise the importance of certifications, premiums, and enforcement. Rode et al. (2023, this issue) mention that legal requirements of trees and protected areas are important. However, there appear to be strong hurdles in implementing and enforcing them, such as unclear responsibilities, corruption, and diverging interests. Grima et al. (2017) mention Payments for Ecosystem Services as a way of mainstreaming biodiversity while also addressing social goals such as poverty alleviation. In 6 cases, the type of policy instruments at issue are not specified. Legal instruments are observed in 6 cases, information-based instruments in 2. Xie et al. (2022) mention contractual agreements and co-financing arrangements as important for promoting urban nature-based solutions.

*Indicator 3: Monitoring and follow-up*

Monitoring and follow-up mechanisms seem to be key for bridging the implementation-gap in biodiversity policy (e.g., Xu et al., 2021). Based on the example of Bangladesh, Siddiqui (2013) argues that national biodiversity accounting can assist poor nations in responding to stakeholder demands for greater environmental stewardship and accountability. Biodiversity accounting can produce an inventory of natural assets that can be used as a target and legitimate basis for communication with the international community. However, in only 9 cases, monitoring schemes and follow up mechanisms are reported to have been implemented. Cardona Santos et al. (2023, this issue) report that in several countries, the Aichi Targets enable the enhancement of national data collection and establishment of monitoring mechanisms by providing a mandate. Further, the German NBSAP is observed to enable a standardised structure for the biennial national accountability reports. However, most papers remain silent about responsible actors of these monitoring and follow-up mechanisms. Governmental actors are reported in 3 cases as implementers of monitoring schemes, while private implementers are reported only in 1 case. The papers in our sample provide little information regarding *bindingness* of monitoring schemes: 3 cases deal with mandatory monitoring schemes and 1 case with voluntary schemes. Nevertheless, 5 cases provide detailed information on characteristics of the monitoring schemes at issue in terms of frequency of monitoring, while 5 others focus rather technically on specific monitoring techniques or specific indicators.

**Coherence**

*Indicator 1: Addressing driving forces of biodiversity loss and sectoral policies that create or facilitate these*

Over half of the cases explicitly address the driving forces of biodiversity loss in specific sectors and, though a bit less often, the policies that create or facilitate these. Bisht et al. (2020) provide an example of BPI in the Indian agricultural sector by stimulating agroecology, which is however competing for resources with conventional-modern agriculture. Using the example of promoting tree planting on farms in the country, Rode et al. (2023, this issue) observe a lack of ownership in

addressing driving forces. Instead, the governing actors involved focus on specific sub-topics. Xie et al. (2022) provide examples of how utilities (e.g., water, waste, energy) and network service providers (e.g., road, rail, and waterway authorities), via contractual agreements, can be encouraged (or required) to work with nature in their infrastructure development and in this way address related driving forces.

*Indicator 2: Coherence between sectoral policies and biodiversity targets*
As the literature on BPI in agriculture already suggests (Zinngrebe et al., 2022), BPI efforts mostly classify as 'add-ons' for those cases where information is provided. In only 4 cases, researchers report that all policies were adjusted to support biodiversity. Rode et al. (2023) reports coherent policy adaptions during agri-environmental schemes with a group of farmers via planning on a landscape scale. Significantly more often (19 cases), authors reported a co-existence of the promotion of biodiversity-related goals and sector goals. Perverse incentives continue to exist, for example, in agriculture and forestry (Simoncini et al., 2019; Sotirov and Storch, 2018). Further, Alblas and Van Zeben (2023) emphasise the importance of social policies, to which biodiversity policies must be coordinated to enable a coherent policy mix, as well as the importance of coherence along the vertical multi-level governance.

Urban nature-based solutions aim to use nature or natural processes to contribute to both sectoral targets (e.g., water storage) and other goals (e.g., biodiversity and social cohesion) (Dorst et al., 2019). By employing 'green' instead of 'grey' solutions (e.g., sustainable urban drainage systems instead of sewage systems), a driver of biodiversity loss (in this case: loss of green area) can be avoided. It can also lead to synergies between sectoral and biodiversity targets ('harmonisation' in terms of the BPI criterion of weighting). Xie et al. (2022) provide examples of how utilities (e.g., water, waste, energy) and network service providers (e.g., road, rail, and waterway authorities) can be incentivised through contractual agreements (or required) to incorporate nature into their infrastructure development, thereby addressing related driving forces.

Researchers have reported an increased recognition of the need of linking of biodiversity recovery with climate change mitigation and adaptation, especially at the level of transnational governance initiatives (e.g., Bulkeley et al., 2023). Yet, in our sample of papers, we found few references to climate change being a substantial factor for promoting BPI, except for the case of (urban) nature-based solutions. This may be explained by the novelty of the phenomenon, or that is has been studied under labels other than biodiversity integration/mainstreaming.

**Capacities**
*Indicator 1: Money, people, knowledge, organisational structures, etc. to ensure "operationalisation"*
In about a quarter of the cases, researchers conclude that sufficient capacity was either already available or had been created to achieve the biodiversity targets. Dik et al. (2023) report that in the Dutch agri-environment scheme sufficient resources covering money, people, knowledge, and organisational structures are organised to ensure operationalisation by farmer collectives. In the majority of cases where capacities are discussed, the focus is on financial capacities (20 cases). Despite the importance of directing funds explicitly to biodiversity action, Siddiqui (2013) observes that biodiversity funding in Bangladesh is taken from international funding for other purposes (e.g., climate global change fund), which implies competition between sustainability targets. In 15 cases, capacities

of actors are discussed (8 cases on institutions and 7 cases on humans). In 9 cases, capacities are mentioned in a generic way. Lack of knowledge or awareness in general is addressed in 4 cases, while just 1 case focuses on a lack of societal awareness. Smith and Wolfson (2004) highlight the importance of initial plant diversity audits and on-going taxonomic lists in South Africa for emphasising the global importance of the Cape Region as a biodiversity hotspot, which ultimately led to donor funding being made available for specific biodiversity projects.

**Weighting**

*Indicator 1: Financial allocation*

In terms of the allocation of funding to biodiversity vis-à-vis sectoral policies that support driving forces of biodiversity loss, the pattern is similar to that of 'coherence' and 'capacity'. Biodiversity targets are clearly not prioritised, the situation classifies more as 'coordination' and, to a lesser extent, 'harmonisation' (see Section 2.3.). Some funding is directly allocated to biodiversity specific activities, such as to Agri-Environmental Measures in the Netherlands ((Dik et al. 2023) or policies on invasive alien species in South Africa (Redford et al. 2015). Many cases report a low priority of biodiversity in the allocation of funding, e.g., reflecting their low priority in forest policy (Sotirov and Storch 2018), for assessing biodiversity in land-use planning (Shih and Mabon 2018) or for the implementation of NBSAPs (Cardona Santos et al. 2023). Instead, large shares of funding support biodiversity threats and thus function as potentially harmful subsidies, including foreign direct investments (Karlsson-Vinkhuyzen et al. 2018), bank loans (Rode et al. 2023), or governmental funding (Pröbstl et al. 2023).

In land use planning, we found a few cases where funding for biodiversity seems more substantial. For instance, in Durban, South Africa, funding for biodiversity integration is made available. In the UK net biodiversity gain policy mentioned above also implies a mandatory reallocation of funding for biodiversity (Wilson, 2023; see also Xie et al., 2022). At the same time, ineffective implementation can be a barrier, as for instance in Peru, *"Regional governments used up to 83% of available budgets up to 2015 and only 3.3% for conservation"* (Zinngrebe, 2018). Private funding has potential for closing finance gaps as indicated for certification schemes (Garraud et al., 2022) or the co-funding of biodiversity measures in an urban context (Xie et al., 2022).

*Indicator 2: Decision making*

There seems to be an overall resistance for giving a stronger consideration of biodiversity considerations in sectoral decision making. Analysing forestry policy in Netherlands, Germany, France, and Sweden, Sotirov and Storch (2018) refer to this resistance as 'sectoral resilience', i.e., *"(…) to absorb, minimise and recover from the pressure built by environmental actors and the general public to integrate international, EU and national biodiversity policy into forest policy"* (Sotirov and Storch, 2018: p. 977). Analysing different Peruvian sectors, Zinngrebe (2018) points to diverging sustainability concepts in the assessment of policy impacts, generally disregarding biodiversity impacts and particularly indirect biodiversity impacts generated for instance through migration following road construction, ecosystem service loss after mining activities, or extractive practices supported by the sector for economic and finance. Sectors provide general guidelines for biodiversity action however without guiding trade-off decisions, for instance in mining (Holness et al., 2018) or in agriculture (Simoncini et al., 2019). Even within NBSAPs developed by the environmental sector, activities focus on mitigation or compensation (Pröbstl et al. 2023) and do not address harmful subsidies and incoherent incentives (Cardona Santos et al. 2023). Land-use planning processes suffer from generic,

unspecific framing of biodiversity (Shih and Mabon 2018), whereas foreign direct investments give little overall importance to biodiversity (Karlsson-Vinkhuyzen et al., 2018). The UN Treaty for Marine Biodiversity is supposed to prioritise biodiversity, but its implementation remains uncertain (Barirani, 2021).

The unbalanced prioritisation of knowledge systems is another lever for biodiversity. Indigenous and local knowledge is found to receive little attention in assessments, policy design and decision-making Fajardo et al., 2010). Evaluations on ' bioeconomy' (i.e., "economic sectors and activities that apply biological processes and principles to create new products, services, and renewable raw materials" – Queiroz-Stein and Siegel, 2023: 1) tend to be technocratic processes dominated by powerful actors that exclude traditional knowledge holders and other biodiversity aspects (Savianu et al., 2021).

### *4.3. Research question 2: What enabling and hindering factors and processes explain the results of BPI efforts in terms of their (potential) contribution to biodiversity protection and recovery?*

From Table 2 we learn that in a bit over 80% of all cases, joint planning processes were reported as having played a role in achieving BPI, either positively or negatively. While somewhat less frequently reported, consistent policy revision and adaptive learning are still evident in over half of the cases.

*Table 2: Evidence about explanations for the degree of Biodiversity Policy Integration reported in the sample of papers*

| **Indicators** | **Share of papers providing information** | **Salient aspects** |
|---|---|---|
| ***Enabling and hindering factors and processes*** | | |
| Joint planning | 83% | ● Inclusion of diverse value perceptions<br>● Inclusion of diverse knowledge<br>● Co-designing policies<br>● Allocating responsibilities<br>● Mobilising specific actors<br>● Provision of data and information<br>● Secure legal status of processes (e.g., NBSAPs) |
| Revising policies | 61% | ● Establishment of monitoring and review processes<br>● Provision of robust data<br>● Provision of resources<br>● Recognition of institutional capacities<br>● Include different political levels and stakeholders in the revision process<br>● Mediation between institutions<br>● Secure legal status / mandate of processes (e.g., NBSAPs)<br>● Change incentive structures |
| Adaptive learning | 57% | ● Enabling systematic evaluation and monitoring<br>● Enabling knowledge exchange<br>● Include actors in revision processes<br>● Transform problem definition of actors<br>● Strengthen science-policy interfaces<br>● Strengthen accountability<br>● Strengthen political mandate of biodiversity and institutional flexibility<br>● Provide resources for the revision of policies |
| ***Structural conditions*** | | |
| Physical circumstances | 20% | ● Increasing awareness of the socio-environmental benefits of open greenspace in cities |

| Indicators | Share of papers providing information | Salient aspects |
|---|---|---|
| | | ● Increasing awareness for the importance of biological diversity for medical use, especially in developing countries |
| Physical infrastructures | 9% | ● Urban grey infrastructure creating path-dependencies against investing into nature-based solutions<br>● Urban green-infrastructure as long-term investment for social-environmental benefits |
| Institutional settings | 76% | ● Assignment of responsibility undermined by competing sectoral targets.<br>● Power inequalities present amongst actors.<br>● Lack of long-term commitments.<br>● Enablers: Environmental risk is becoming more embedded in financial models. |
| Discourse | 54% | ● Biodiversity discourse influences the BPI scope.<br>● Overly economic language negatively affects the biodiversity discourse. Alternative discourses should be considered (e.g., from indigenous and local communities) |
| Agency | 59% | ● Agency can act both as a barrier and enabler. |
| Shock events | 13% | ● Examples: COVID-19, Ukraine war |

**Joint planning**

A joint planning process forms an important precondition for enabling BPI (Zinngrebe et al., 2022). The role and importance of joint planning emerges in different ways. The inclusion of diverse value perceptions, world views, and interests is reported for 9 cases as being important for inducing ownership for BPI by stakeholders (Zinngrebe et al., 2022). Boundary concepts and targets (e.g., nature-based solutions, ecosystem services), brokering language (e.g., a joint indicator scheme) as well as workshops and working groups support this process (Pröbstl et al., 2023, this issue). This can also involve the combination or alignment of biodiversity targets with other strategic priorities, such as climate adaptation and health support through nature-based solutions in cities (Xie et al., 2022). In the case of agri-environmental schemes in the Netherlands, Dik et al. (2023, this issue) report on the importance of having a shared strategy for agrobiodiversity for effective implementation of this form of BPI.

12 cases report the co-design of policies via cross-sectoral or cross-level interactions (e.g., inter-ministerial working groups), alignment of monitoring schemes, as well as cross-references in planning processes and agreements. These processes support the alignment of goals and resources, as well as the development of a joint language. In 16 cases, it is stressed that responsibilities need to be allocated in these processes, whereas the importance of a legal status of BPI processes via inter-ministerial or inter-governmental agreements or a reference framework and control plan defined by law and set by decree is emphasised in 5 cases. For instance, in the context of biodiversity-related multilateral environmental agreements, political agencies representing their national governments struggle with mobilising other governmental bodies to take action on implementing the multiple decisions adopted at convention meetings (Gomar, 2016).

In addition, the importance of incorporating different knowledge systems is observed in 5 cases, which also found that knowledge, as well as all relevant data and information, should be available to all relevant stakeholders. Investments both into the build-up and the visibility of data platforms are

necessary in this regard for enabling sufficient knowledge exchange. Queiroz-Stein and Siegel (2023, this issue), Bisht et al. (2020), and Fajardo et al. (2021) stress the need to overcome technocratic models of policy making in favour of collaborative governance processes, especially by ensuring the direct participation of traditional knowledge holders on the use and management of biodiversity, such as indigenous peoples and peasant farmers.

3 cases refer to the importance of mobilising specific actors who can bring different stakeholder groups together to search for common targets. These specific actors may emerge in different forms, e.g., *"issue specialists can act as brokers or entrepreneurs between sectors by being involved in various policy processes at the same time"* (Reber, 2023: 96-97). Karlsson-Vinkhuyzen et al. (2018: 137) further emphasise *"In the start-up phase of mainstreaming in governance contexts it takes strong leaders with convening power to bring together unlikely groups of stakeholders and stimulate courageous conversations."*. According to Suarez (2023), *"ideological functionaries as powerful actors with authority, visibility and credibility have the position to change ideological foundations - integrating them in strategic alliances can help making changes in the ´rule of the game´".*

**Revising policies**

Another important precondition for improving the level of BPI is the revision of policies, both as part of the joint planning process as well as in continuous adaptive evaluation processes. In order to provide the required knowledge, it is reported that generated data should be robust and openly accessible (1 case), and that different perceptions and values should be reflected in the revising processes (4 cases).

In line with this, it is concluded that the inclusion of different political levels and stakeholders in the revision process itself (2 cases) is important, as well as the recognition and provision of necessary institutional capacities and resources (e.g., financial, personal, time) for enabling long-lasting revisions (5 cases). The example of trees on farms shows that many capacities are already existing in many countries, providing technical assistance, material support (e.g., for seedlings or alternative technology), credits and insurance schemes, markets and certification mechanisms or support funding (Rode et al., 2023, this issue). However, these capacities must be adjusted and conditioned to their applicability and support for biodiversity found land-use practices while phasing out harmful subsidies, which requires adjustments in legal frameworks, governmental spendings, design of credit schemes and others (Rode et al., 2023, this issue).

Another case focusing on multilateral environmental agreements illustrates the challenges for mobilising implementation action across sectors, levels, and stakeholder groups to avoid turf battles and competition for resources. The experience with national implementation of these treaties shows that integration and policy adjustments are conducted in diverging dynamics leading to incoherent, asymmetric structures and an unequal distribution of costs between stakeholders and countries (Gomar et al., 2016). More integrative work both between the conventions, as well as in national implementation (e.g., through the integrative potential of National Biodiversity and Action Plans) is needed to overcome these asymmetries and structural barriers (Gomar et al., 2016).

Finally, in 5 cases it appears that the legal status or mandate given to the revision process needs to be secured. This may entail support from an international, national, or sub-national perspective, as well

as governmental or public backing. The example of NBSAPs in multiple countries shows that the legal status of biodiversity targets is a central lever for holding policy sectors accountable for implementing biodiversity targets and adjusting their policies accordingly (Cardona Santos et al., 2023, this issue).

**Adaptive learning**

For enabling adaptive learning, 13 cases show the importance of systematic evaluation and monitoring processes. Ideally, these processes would cover evaluations of biodiversity performance and natural inventories, as well as headline indicators for BPI. Further, they should be designed as long-term evaluations (e.g., a second-generation checklist is usually considerably more useful and complete than a first attempt) and grey literature (e.g., reports by development cooperation) should be mobilised. The case of farmer collectives illustrates however that merely producing data is not enough. Here, biodiversity data is produced and stored on a frequent basis, which is not enough to enable learning processes (Dik et al., 2023, this issue).

Similar to the 2 prior factors, exchanging knowledge seems vital for enabling adaptive learning (5 cases). Thus, data formats need to be standardised and stored in user-friendly databases with the corresponding metadata, central accessibility of background information (e.g., accountability reports on nature-based solutions) need to be provided, and needs to be openly accessible. In addition, the collected data should represent multiple knowledge systems and pay particular attention to local and traditional knowledge. The experience of traditional framing systems in India shows that involving traditional knowledge holders in collaborative implementation strategies can be a powerful lever for developing and implementing solutions in agricultural landscapes for climate adaptation, local food production, and ecosystem services: *"We need policies that engage native communities, as key partners, in climate change research and adaptation plans"* (Bisht et al., 2020, p.14).

The importance of strengthening science-policy interfaces is emphasised in 3 cases, as evaluations must be adjusted to the targeted problem and audience, as assessments often do not reach decision makers directly, but in an accumulated processed way instead, depending on communication channels and formats, ideological constraints, and interests. Thus, the relevance of assessments is conditioned by the science-policy-interfaces they are communicated from. Revising institutional settings is central for defining how knowledge enters decision making processes. Some authors argue that social science research must receive increased attention. Queiroz-Stein and Siegel (2023, this issue) for instance emphasise that transforming the problem definition of the actors (e.g., by adapting recommendations to the national context) is a precondition for enabling stakeholders to adapt policies.

Involving actors (policy makers, NGOs, citizens, and other stakeholders) directly in the revision process seems a central element of successful learning processes (9 cases). Several arrangements are mentioned, including intersectoral groups, inter-ministerial working groups, cross-cutting environmental assessment processes, partnerships, and citizen science. Inter-organisational cooperation is stressed in the context of both national and international agreements (e.g., CBD). Bisht et al. (2020) stress that top-down management represents a general problem regarding adaptive learning, and that it is important to avoid asymmetric adjustments along vertical administrative levels through coordination. Skilful coordination and deployment of resources, learning through exchange, and boundary objects can facilitate these processes.

In 6 cases, strengthening the political mandate given to revision processes (e.g., of NBSAPs) or the responsible institutions themselves appears necessary to foster BPI. For 5 cases it is recommended to strengthen accountability (e.g., by specific exchange formats or public pressure), as well as to provide the needed resources (e.g., financial, personal, organisational) to be able to review and complete the corresponding revision process. For example, in the case of ecosystem service assessments, the way knowledge enters policy processes in terms of user-friendliness, transparency, flexibility, format (quantitative and qualitative), scientific reliability, broader outreach to stakeholders, and engaging methods, determines its ability to produce policy impacts (Zolyomi et al., 2023, this issue).

### *4.4. Research question 3: What structural conditions influence the scope for BPI, and what explains the emergence or absence of these conditions?*

In this Sub-section, we discuss our findings regarding the structural conditions hindering or favouring BPI efforts and the enabling factors and processes, discussed above, group-wise. Table 2 shows that institutional settings are most frequently reported (76% of all cases), followed by agency (59%) and discourse (54%). The other conditions, more physical in nature and therefore discussed together, were reported less often. This may in part be related to the scope of research, as we expect that policy scientists and social scientists will be likely to focus more on social-institutional conditions. Nevertheless, it can also reflect the relative importance of the structural conditions we included in our conceptual framework.

**Institutional settings**

Institutional settings, which appear in many different forms throughout the cases, seem among the most important structural conditions for BPI. BPI is a response to the observation that biodiversity targets are not automatically strived after in policy sectors outside the environmental domain. The often voluntary character of BPI means that sectoral biodiversity action ultimately depends on the willingness and ability of governments, companies, and other sectoral stakeholders. This situation forms the institutional basis for BPI. To understand the scope for BPI, it is important to understand the specific institutional setting of policy sectors, which is nicely illustrated by the following quotation of Karlsson-Vinkhuyzen et al. (2017: 146): *"Better identification of opportunities for mainstreaming biodiversity in economic sectors requires an understanding of how and by whom such sectors are governed that moves beyond the governmental view of steering"*.

Our literature review has yielded a variety of specific institutional conditions that constrain BPI. A first institutional condition refers to the assignment of responsibilities for conservation being undermined by competing other responsibilities for sectoral targets (e.g., Sarkki, 2016). Second, regarding how institutions matter, Queiroz-Stein and Siegel (2023, this issue) argue that a central aspect is the way they distribute power among stakeholders and their degree of openness in regard to the participation of historically marginalised actors. Third, there is usually no long-term 'anchoring' of BPI resources. This does not only apply to financial resources, as for instance donor-driven BPI activities in development contexts often take place on a project- and not a programmatic basis, but also because BPI professionals have no 'home', i.e., no professional organisation such as the IUCN (Huntley, 2014).

Conditions that provide opportunities for BPI are also reported. For instance, *"(..), increasingly, financial institutions are embedding environmental risks in financial models, and recognising the*

*parallels between the systemic risks of the financial sector and the systemic risks associated with ecosystems"* (Huntley, 2014: 2). Friedmann (2018) reports on BPI in the fisheries sector being positively influenced by a history of conservation standards and policies, resulting in more shared understandings and collaboration between the fisheries sector and the environmental sector. And Sotirov and Storch (2018) observe how, over time, forestry policy makers gradually adopt biodiversity values, however without general resilience to structural adjustments. They find that *"in a nutshell, coalition strength (power), coalition unity (ideological cohesion), and ideological congruence (compatibility between goals/beliefs of policies/coalitions) can be identified as causal factors behind the different types of policy change processes/outcomes in the quest to respond to policy integration pressures."* (Sotirov and Storch, 2018: p. 987).

**Discourse**

The way actors talk about biodiversity and its governance is reported to influence the scope for BPI. In this respect, Karlsson-Vinkhuyzen et al. (2017) observe that market-based approaches to BPI are perceived negatively by various actors. Xie et al. (2022) note that biodiversity has been relatively marginalised in urban planning in Europe. This marginalisation stems from a discourse that views cities as separate from nature. Research that examines nature-based solution projects in European cities finds that only a little over a third (351 out of 976) projects have explicit biodiversity goals and actions (Xie and Bulkeley, 2020). According to Xie et al. (2022), mainstreaming urban nature-based solutions to address biodiversity concerns requires therefore shifting existing thinking and practice. Some authors (Fajardo et al. 2021; Bisht et al. 2020; Shih and Mabon, 2018; Sotirov and Storch, 2018; Whitehorn et al., 2019; Zolyomi et al., 2023, this issue) emphasise the importance of considering alternative discourses, especially those that aim at establishing relationships between society and nature, such as the spiritual roots of agroecological practices, present in indigenous peoples and local communities. These articles also underline the importance of values and changes in values: *"An overly economic language might narrow down the discourse on biodiversity conservation, whilst a plurality of values with respect to biodiversity might be needed for successfully protecting biodiversity"* (Whitehorn et al., 2019: 162).

**Agency**

Agency by involved actors can operate both to promote mainstreaming and to actively build barriers to it. This is clear in the bioeconomy field. As argued by Queiroz-Stein and Siegel (2023, this issue: p.4): *"Often, governments and other powerful actors, such as large economic conglomerates and associations representing the private sector, have no interest in measuring the negative impacts of the development of the bioeconomy nor in developing appropriate regulatory measures since these could mean increased costs and restrictions on their actions in the markets. Dealing with these issues goes beyond purely institutional solutions and depends to a large extent on the organizational capacity and political pressure of social movements, networks of grassroots organizations, and conscious consumers."*

In some cases, pleas are made for enhancing agency to contribute to biodiversity recovery. Bisht et al. (2020) note that the *"potential of farmers' experiential knowledge, however, is not being optimally used and a better strategy to integrate various forms of knowledge is needed"* (p.14)

While political will is important for promoting BPI (e.g., Friedmann, 2018), it is often reported as a hindering factor (e.g., Zolyomi et al., 2023). Siddiqui (2013) observes a lack of political support for biodiversity due to corruption and poverty, whereas Zinngrebe (2018) observes how a decentralisation of environmental competencies to sector ministries and regional and local governments may create an institutional void in which eventually no actor shows political will to implement biodiversity action. Cardona Santos et al. (2023, this issue) report pleas for strong legal frameworks with long-term (i.e., beyond election periods) commitments to biodiversity integration to overcome a lack of political will or fluctuating political support.

**Physical circumstances, physical infrastructures, and shock events**

In about 20% of the cases, physical circumstances appear to be important for the scope for BPI. Pröbstl et al. (2023, this issue) report that the Covid-19 crisis and the Ukraine War act as potential policy windows. However, these crises have not been utilised for shifting narratives and stronger biodiversity conservation. Sevianu et al. (2021) and Bisht et al. (2020) identify a negative impact of the Covid-19 crisis on 2 BPI cases they analyse. However, for a third case in India, they consider the reverse migratory flow of young people from cities to the countryside after the pandemic as an opportunity to advance agroecological transitions (Bisht et al. 2020).

## 5. Discussion and Conclusion

**Key findings, reflections, and suggestions for future research**

The integration or mainstreaming of biodiversity in sectoral policies and plans has been recognised in international biodiversity agreements as an important approach to contribute to biodiversity recovery. Our literature review encompassing empirical research on Biodiversity Policy Integration (BPI) reveals that biodiversity targets are usually defined too broadly, providing little guidance to action. Surprisingly, in relatively more cases, measures are implemented to work towards biodiversity targets, reflected in the specification of behavioural changes (such as management practices) and the implementation of policy instruments, and, to a lesser extent, in monitoring arrangements. This contrasts earlier meta-analyses of climate adaptation mainstreaming and environmental policy integration research reporting a lack of translation of targets into action ('implementation gaps') (Runhaar et al., 2018; 2020). This is a positive signal as it indicates activity, even though the actions may not always appear goal-oriented. Simultaneously, we observe that the capacity to facilitate implementation seems inadequate.

As central enabling conditions for improving or blocking BPI, literature confirms the expected relevance of joint planning, consistent policy revision, and adaptive learning . Joint planning – bringing actors together and finding joint solutions - seems to be particularly important. This further requires the consideration of different knowledge systems and the facilitation of participatory processes in new modes of collaborative governance. In this sense, collaborative arrangements between sectors and levels can allow for the co-design, co-implementation, and co-evaluation of policy processes in order to assure their positive influence on biodiversity. Improving implementation requires a consistent revision of all policies with a biodiversity effect. Phasing out harmful subsidies and targeting the driving forces of biodiversity loss is central and requires overcoming resistance and mitigating sector concerns. At the same time, support can be redirected to scaling up successful pilots and innovative potential. Finally, the overall impression on adaptive learning is that data and evaluation

processes are not organised in a way that allows for the identification and improvement of underlying factors. Science-Policy-Interfaces hold a bias towards certain knowledge systems and lack the institutional structures to produce the accountability among governmental actors to respond to them and adjust institutional setting to support BPI.

A third and final finding is that institutional settings form the most often reported structural conditions determining the scope for BPI, followed by agency and discourse. Other types of structural conditions that have been identified in previous literature on policy change, such as physical circumstances and shock events, seem to play a far less important role in the case of BPI. Problems in institutional settings include unclear responsibilities for BPI, the inability to enhance the mandate for BPI in sectoral policies and institutions, and a project-based rather than programmatic approach to BPI, among others. Follow-up research is required to uncover the mechanisms that impede structural changes in institutional settings; to identify the institutional arrangements that can provide leverage for BPI such as more strict requirements for BPI, more explicit responsibilities, and enhanced accountability mechanisms; and to explore windows of opportunity for institutional change (for instance, the role that physical conditions, that thus far do not seem to play an important role in providing space for BPI, may play). The discourse, including how biodiversity is being framed and discussed, appears significant. It would be interesting to conduct a more in-depth analysis of the apparent popularity of concepts such as urban nature-based solutions (while critically examining its implications for actual biodiversity recovery; see Seddon et al., 2019). The same applies for agency, particularly political will and leadership for enhancing BPI: What explains the reasons behind certain leaders in politics and industry advocating for BPI, and to what extent is such leadership person- and context-specific?

Part of the answers, or at least directions for future research, can be found in related literature on environmental policy integration, in the new but growing literature on the steering effects of global targets (e.g., Biermann et al., 2022; Bogers, 2023) as well as in literature on nexus governance, (integrated) landscape governance, and environmental governance by non-state actors (e.g., Kok and Ludwig, 2022).

**Limitations**

The systematic approach in our paper has yielded initial insights into the manifestation of BPI and, more importantly, has identified enabling and hindering factors and processes that contribute to BPI achievements. Additionally, we've examined what structural conditions influence the scope for BPI. Our study has 4 limitations. First, we only included peer-reviewed scientific research articles that provide empirical evidence of BPI and identified relevant literature in the Web of Science (see Section 3.1.), which potentially excludes relevant scientific work published in books (such as Zinngrebe et al., 2022). We also excluded 'grey' literature such as policy reports, which may have provided further insights. Two, we selected only those papers that explicitly employed the concepts of biodiversity policy integration or mainstreaming, which might imply we missed relevant literature that focuses on specific forms of BPI but under different labels (e.g., that of nature-based solutions). Three, we relied on secondary data, and interpreted and coded research articles that usually employed questions and frameworks different from ours. This is reflected, among other things, in the share of missing data per BPI indicator and explanatory variables (see Tables 1 and 2). Follow-up primary data collection can ensure a larger empirical data base, also regarding the fourth limitation of our study, which is related to a possible geographical bias. We systematically searched for literature on BPI and biodiversity

mainstreaming, identifying mainly studies conducted in Europe, not necessarily reflecting BPI practice. In other regions and countries, there might be less funding for BPI research or different terms might be employed (cf. Runhaar et al., 2020).

**Practical implications**

Our literature review shows that the expectations of the integration or mainstreaming of biodiversity in sectoral policies and plans are not, or not yet, met. We see the following practical implications of our study. One, the BPI indicators from our analytical framework (see Section 2.3) can be used by governments, companies, and environmental NGOs to measure and monitor progress in BPI, for instance within the system for planning, monitoring, reporting and revision of the new GBF. Two, the list of enabling and hindering factors (Section 2.4) and structural condition (Section 2.5) can be used to structure a dialogue on existing BPI strategies: what are key bottlenecks for enhancing BPI and which ones can be overcome by whom and how? Our analysis suggests that a purely voluntary approach to BPI will not work and that a combination of 'sticks' and 'carrots' (Weber et al., 2014) may be more promising. The stick in this case is a binding (legal) requirement to implement BPI interventions whereas the carrot consists of the potential contributions of biodiversity to sectoral goals (think of nature-based solutions and ecosystem services). Although no silver bullets (see Zolyomi et al., 2023, this issue) this approach can further structure dialogue and joint planning processes and facilitate the search for a joint vision – important enabling factors for fostering BPI. Three, even though specific measures to promote BPI will be context-specific and cannot be directly translated from 1 case-study into universal policy recommendations, some of the studies included in our database may provide inspiration.

While commitments to "whole of government" and "whole of society" approaches have entered international and national agendas, real biodiversity integration or mainstreaming requires the adjustment of institutional settings and overcoming persistent power structures, to allow for joint planning, consistent policy revision, and adaptive learning. We do hope that policy makers and politicians consider structural conditions that set the scope for BPI more explicitly, for instance in the institutional and financial arrangements accompanying the development and implementation and of NBSAPs.

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**Annexes**

1. Papers on BPI included in the coding
2. Coding scheme
3. Guideline for coding
4. Descriptive results

## Annex 1: Papers on BPI included in the coding


1. Alblas, E. and van Zeben, J. (2023), 'Farming out' biodiversity: Implementing EU nature law through agri-environmental schemes, Earth System Governance, 17, 100180.
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41. Xie, L., Bulkeley, H. and Tozer, L. (2022), Mainstreaming sustainable innovation: unlocking the potential of nature-based solutions for climate change and biodiversity, Environmental Science & Policy, 132, pp. 119–130.
42. Zinngrebe, Y. M. (2018), Mainstreaming across political sectors: Assessing biodiversity policy integration in Peru, Environmental Policy and Governance, 28(3), pp. 153–171.
43. Zolyomi, A., Franklin, A., Smith, B. and Soliev, I. (2023), Ecosystem services as the silver bullet? A systematic review of how ecosystem services assessments impact biodiversity prioritisation in policy, Earth System Governance, 16, 100178.

## Annex 2: Coding scheme

| **Basic information** | | | |
|---|---|---|---|
| Sector | | | |
| Country | | | |
| BPI intervention in the paper (2-3 sentences) | | | |
| Aim of the paper | | | |
| **BPI indicators** | **Scale per indicator (please select)** | **References** | **Explanation** |
| ***Inclusion** - The extent to which the objective of biodiversity conservation is included in the unit of analysis in the paper (sector or a specific policy etc.).* | | | |
| *Biodiversity targets - qualitatively* | 1. Specified (SMART: specific, measurable, action-oriented, responsible, time-bound).<br>2. Mentioned in qualitative terms only.<br>3. Unclear or not mentioned (please, specify). | Kivimaa and Mickwitz, 2006; Uittenbroek et al., 2013; Zinngrebe, 2018; Zinngrebe et al., 2022 | For instance, targets are specified and reference is made to international biodiversity agreements. |
| *Biodiversity targets - quantitatively* | 1. A substantial part of the sector is addressed by the BPI intervention.<br>2. A small part of the sector is addressed or involved.<br>3. Unclear or not mentioned (please, specify). | Runhaar et al., 2017 | A large number of companies or other organisations is addressed or, in the case of forestry or agriculture, a large part of the land surface is involved (NB: this does not say anything about the level of ambitions of the targets, only about the scope of the BPI intervention). |
| ***Operationalisation** - the extent to which targets have been translated to sector instruments, monitoring and enforcement procedures in the analysed case* | | | |
| Outcomes specified | 1. Desired behavioural changes of sectoral actors are specified (e.g., good and bad agricultural practices).<br>2. Desired behavioural changes are mentioned but vaguely.<br>3. Unclear or not mentioned (please, specify). | Runhaar et al., 2017 | For instance, reference could be made to the EU Taxonomy that specify 'green' investments that, among other things, should contribute to the goal of "Protection and restoration of biodiversity and ecosystems" (https://eu-taxonomy.info/info/eu-taxonomy-overview).<br>Another example: based on literature review, tables of good ecological practices and examples of indicators for cropland (Table 5, p32; Table 6 p33), dairy (Table 2, p27 and Table 3, p29), forestry (Table 9, |

| | | | |
|---|---|---|---|
| | | | p42), marine aquaculture (Table 11, p48). See https://op.europa.eu/en/publication-detail/-/publication/26949618-735c-11ec-9136-01aa75ed71a1/language-en |
| Policy instruments to work towards the targets | 1. Policy instruments (or other concrete actions) are implemented.<br>2. Policy instruments are mentioned but not implemented.<br>3. Unclear or not mentioned (please, specify). | Kivimaa and Mickwitz, 2006; Uittenbroek et al., 2013; Zinngrebe, 2018; Zinngrebe et al., 2022 | Examples of policy instruments: subsidies, taxes, legislation, collaboration, covenants, etc. |
| Monitoring and follow-up | 1. Monitoring schemes implemented, including a procedure for follow-up actions if biodiversity targets are not achieved<br>2. Monitoring schemes mentioned but not implemented.<br>3. Unclear or not mentioned (please, specify). | Kivimaa and Mickwitz, 2006; Uittenbroek et al., 2013; Zinngrebe, 2018; Zinngrebe et al., 2022 | |
| ***Coherence*** *- the extent to which the intervention addresses the driving forces of biodiversity loss within the sector at issue and the extent to which policies that regulate driving forces are adapted to enhance biodiversity conservation and recovery* | | | |
| Driving forces | 1. The intervention at issue addresses the driving forces of biodiversity loss in the policy sector and is connected to sectoral policies that have created/facilitated these driving forces.<br>2. The intervention mentions the driving forces of biodiversity loss in the policy sector at issue but does not mention the specific sectoral policies that need to be adjusted.<br>3. Unclear or not mentioned (please, clarify). | Kivimaa and Mickwitz, 2006; Uittenbroek et al., 2013; Zinngrebe, 2018; Zinngrebe et al., 2022 | |
| Coherence between analysed policies / or sector policies s and biodiversity targets | 1. All policies are adapted to support biodiversity targets.<br>2. Support for biodiversity exists, but exists in parallel to support for intensified | Zinngrebe et al. 2022 | This dimension assesses the extent to which a analysed biodiversity intervention / or the analysed sector aligns its activities and |

| | | | |
|---|---|---|---|
| | production or other potential biodiversity threats.<br>3. Biodiversity action is overshadowed by support for biodiversity threats. | | support with biodiversity targets. (Might not be possible to analyse this in all papers) |
| ***Capacity*** | | | |
| Money, people, knowledge, organisational structures etc. to ensure "operationalisation" | 1. Resources (including organisational structures) made available and reasonably sufficient to achieve biodiversity targets.<br>2. No resources made availabe or doubtful whether sufficient.<br>3. Unclear or not mentioned (please, clarify). | Kivimaa and Mickwitz, 2006; Uittenbroek et al., 2013; Zinngrebe, 2018; Zinngrebe et al., 2022 | |
| ***Weighting*** | | | |
| Financial allocation | 1. Large shares of the funding of activities is supporting biodiversity.<br>2. Funding for biodiversity and threats co-exist.<br>3. Large shares of funding go to potentially biodiversity threatening activities.<br>4. Unclear or not mentioned (please, specify). | | What share of financial resources is allocated to biodiversity sound policies in relation to the overall. (Might not be possible to analyse this in all papers) |
| Decision making | 1. Project approbation (EIAs, production, infrastructure etc.) is prioritising biodiversity impacts as factors for approving a project 2. Biodiversity is a valid criterion, but no clear prioritisation required, and/or compensation of biodiversity effects required<br>3. Unclear or not mentioned | | What share decisions are taken with a prioritisation of biodiversity in the process. (Might not be possible to analyse this in all papers) |
| **What is needed? What activities and processes related to the analysed policies or processes analysed can serve as barriers and enablers for improving BPI?** | | | |
| ***Governance criteria*** | **Definition** | **Indicator - how to assess change in this dimension** | |
| *Joint Planning* | Co-developing a joint vision integrating the world views and interests of different relevant stakeholders, defining a clear | Existence of processes to integrate planning processes across sectors, engagement of sectors in NBSAP development, appearance of references and national biodiversity targets in sector strategies | |

| | | | |
|---|---|---|---|
| | mandate for relevant stakeholders, inducing ownership of stakeholders, | | |
| *Revising policies* | The regulatory system and the incentives for biodiversity relevant practices are revised. There are processes to phase out biodiversity harmful subsidies, incentives and regulations. For this purpose, existing views, practices and structures need to be disrupted. At the same time, support for biodiversity sound activities should be increased and administrative hurdles for these need to increased. | There are processes for evaluating and adapting policies with policies being assessed to what extent they contribute to biodiversity. Policies are reviewed - phasing out harmful subsidies and support, while empowering support for effective measures | |
| *Joint Planning* | Co-developing a joint vision integrating the world views and interests of different relevant stakeholders, defining a clear mandate for relevant stakeholders, inducing ownership of stakeholders, | Existence of processes to integrate planning processes across sectors, engagement of sectors in NBSAP development, appearance of references and national biodiversity targets in sector strategies | |
| **Independent variables: success conditions for supporting BPI actions** (at the level of the policy sector more generally). | | | |
| *Physical circumstances* | Qualitative; short narrative.<br>A quotation might be useful (but is not required). | Hegger et al. (2020) | Changes in ecosystems with direct consequences for policy sectors (e.g., reduced soil fertility due to intensive farming practices, leading to an awareness of the importance of soil ecosystem services; e.g., Orchard, S.E., Stringer, L.C., Manyatsi, A.M. (2017), Farmer Perceptions and Responses to Soil Degradation in Swaziland, Land Degradation and Development, 28(1), pp. 46-56).<br>Reduced availability of natural resources, pests, …<br>Growing awareness about the importance of pollinators.<br>Growing awareness in the financial sector about the risks of biodiversity loss. |

| | | | |
|---|---|---|---|
| | | | **Gradual developments (as opposed to shock events, see below).** |
| *Physical infrastructures (man-made)* | Qualitative; short narrative.<br>A quotation might be useful (but is not required). | Hegger et al. (2020) | Infrastructures some degree of stability, but may also reinforce path dependency and lock-in.<br>Investments in grey instead of green infrastructures are fixed for the medium to long term and inhibit investing in e.g. urban NBS. |
| *Institutional settings* | Qualitative; short narrative.<br>A quotation might be useful (but is not required). | Hegger et al. (2020) | Institutions are the "rules, norms and strategies adopted by individuals operating within and across organisations" (Ostrom, 2007, in Hegger et al., 2020: 5) and form "recurrent patterned arrangements which limit the choices and opportunities available, as opposed to agency that is the capacity of individuals to act independently and to make their own free choices" (Hegger et al. 2020: 5).<br>Institutions that may provide or limit the scope for BPI include:<br>- mechanisms to hold specific actor(s) accountable for biodiversity action;<br>- procedures such as EIA or SEA legislation;<br>- a culture of collaboration between public and private actors within a policy sector ('social capital');<br>- the regular evaluation and reconsideration of policies and their outcomes and impacts, which provides space for the consideration of biodiversity targets ('reflexivity' or 'adaptive learning');<br>- and the flexibility or rigidity ('lock-in') of institutions. |

| | | | |
|---|---|---|---|
| *Discourse* | Qualitative; short narrative.<br>A quotation might be useful (but is not required). | Hegger et al. (2020) | 'The views and narratives of the actors involved (norms, values, definitions of problems and approaches to solutions)'.<br>Framing of biodiversity recovery as a cost rather than as a benefit (e.g., Schaal, T., Jacobs, A., Leventon, J., (...), Lindenmayer, D., Hanspach, J. (2022), 'You can't be green if you're in the red': Local discourses on the production-biodiversity intersection in a mixed farming area in south-eastern Australia, Land Use Policy, 121,106306)<br>Framing biodiversity as a value in itself.<br>Competing discourses that inhibit joint action, ... |
| *Agency* | Qualitative; short narrative.<br>A quotation might be useful (but is not required). | Hegger et al. (2020) | Knowledgeable and capable agents (which can be individuals or organisations) (Giddens, 1984) may contribute both to stability and change in modes of governance as they may use their agency both to achieve and to resist change.<br>Political or societal pressure, specific actors using their power (or building coalitions to mobilise power) to take biodiversity action (including the deliberate framing of biodiversity recovery as key to achieving sectoral objectives)(building on Runhaar et al., 2014 JEPG). |
| *Shock events* | Qualitative; short narrative.<br>A quotation might be useful (but is not required). | Hegger et al. (2020) | There is a thin line between physical circumstances and shock events in the case of biodiversity. An example could be the 2017 paper reporting on 75% loss in insects in 30 years. |

## Annex 3: Guideline for coding

*The instructions below were sent to the co-authors who contributed to the coding of the selected BPI papers.*

**Aim and set-up of the paper**

In this paper we synthesise findings from the 8 papers that make up the special issue and put these in a wider perspective, drawing on other studies (35 papers). We want to learn about 'what works' in terms of the mainstreaming of biodiversity targets, or 'biodiversity policy integration' in policy sectors outside the traditional environmental or nature conservation domain, such as agriculture, forestry, fisheries, but also land use planning and transport.

Many of the papers that we want to include in our analysis focus on specific interventions to promote BPI in public but also private sectoral policies and plans, which include, but are not limited to:

- The National Biodiversity Strategies and Action Plans (NBSAPs) that were developed to work towards the Convention on Biological Diversity (CBD) targets.
- Specific sectoral policies aimed at enhancing biodiversity (e.g., agri-environment schemes that provide subsidies to farmers who implement conservation measures in their fields).
- Legal procedures such as Environmental Impact Assessments (EIAs) that incorporate biodiversity in decision-making on sectoral policies or licensing procedures.
- Tools such as ecolabels for biodiversity-friendly products (e.g., Marine Stewardship Council (MSC) label).

Usually, these are implemented in addition to the main sectoral policies and plans that regulate the driving forces of biodiversity loss (e.g., the EU Common Agricultural Policy).

However, other papers in our sample look at BPI at sectoral level. So, there are at least two levels of analysis that can be distinguished.

Below we specify the research questions based on which we ask you to code your paper and ca. 5 additional ones.

For those papers analysing a BPI intervention:

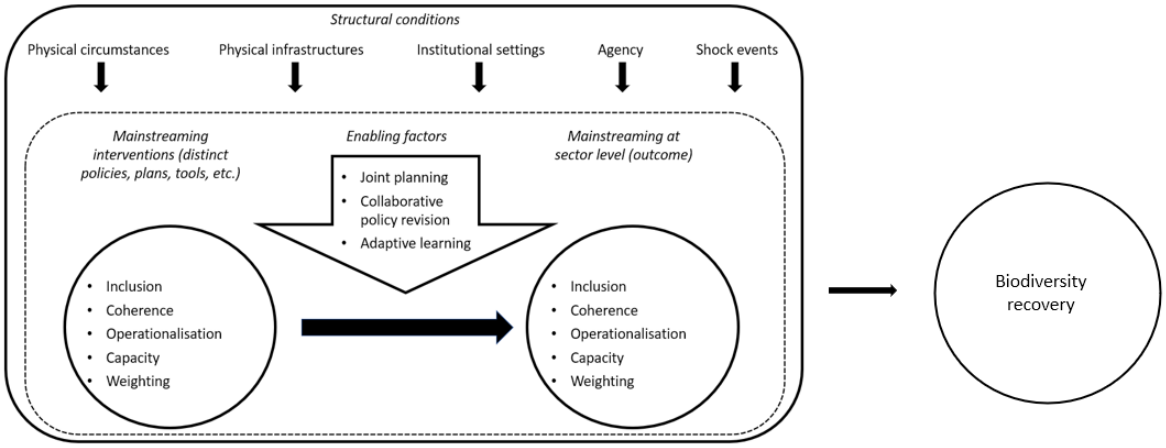
1. Can you characterise the BPI intervention in the paper that you code in terms biodiversity targets, operationalisation etc.? (use BPI indicators).
2. Is there any evidence presented in the paper that the BPI intervention was successful in terms of promoting mainstreaming at sector-level? (use BPI indicators).
3. What enabling and hindering processes are mentioned in the paper to explain the level of BPI achieved through the intervention?
4. What structural conditions explain the level of BPI and the processes, and what explains the emergence or absence of these factors?

For those papers assessing a sector:

1. How are biodiversity targets been integrated in efforts to promote biodiversity, from policy formulation to implementation according to the BPI indicators?

2. What enabling and hindering processes are mentioned in the paper to explain the level of BPI achieved through the intervention?
3. What structural conditions explain the level of BPI and the processes, and what explains the emergence or absence of these factors?

Figure 1 visualises the overall conceptual framework. Below we explain its variables.




BPI indicators

We analyse the level of BPI according to an approach that we have developed based on other policy integration literature in a recent book chapter (Zinngrebe et al. (2022), amongst others:

- *Inclusion*: the extent to which biodiversity targets are specified in the intervention that is analysed in the paper, as well as the scope of the intervention (large part of the sector or only a small part).
- *Operationalisation*: whether or not specific behavioural changes of target groups, needed to realise the biodiversity targets, are specified; the extent to which policy instruments are implemented to achieve the above targets; and the implementation of monitoring schemes to measure progress in achieving these targets, and follow-up procedures to take action in case targets are not achieved.
- *Coherence:* the extent to which the intervention addresses the driving forces of biodiversity loss within the sector at issue.
- *Capacity*: the provision of resources (money, people, knowledge, organisational structures etc.) to ensure the implementation of instruments identified in the "operationalisation" dimension.
- *Weighting:* the political priority of biodiversity targets and policies in relation to other sector targets and policies.

Enabling and hindering factors

The first set of independent variables consist of the following enablers and barriers (based on Zinngrebe et al. (2022), amongst others). These criteria analyse how collaborative processes have been applied to improve the level of BPI within a certain setting:

- *Joint planning*: co-developing a joint vision integrating the world views and interests of different relevant stakeholders, defining a clear mandate for relevant stakeholders, inducing ownership of stakeholders.

- *Collaborative policy revision*: policy makers across political sectors engage in linking and revising their policies in order to phase out harmful subsidies and empower the support for biodiversity policies.
- *Adaptive learning*: actors in the reported case engage in joint evaluation and review processes that strengthen accountability and realign policies.

Structural conditions

The second set of independent variables explain, at a more structural level, the scope for the promotion of BPI. These factors analyse characteristics and dynamics in the political arena that can facilitate or block a policy change as required for BPI. For the analysis, we build on the 2020 Hegger et al. paper[2] that provides explanations for stability and change in modes of governance:

- *Physical circumstances*: e.g., gradual changes in ecosystems with direct consequences for policy sectors, such as reduced soil fertility due to intensive farming practices, threatening food security.
- *Physical infrastructures*: e.g., investments in grey infrastructures in cities for sewage or transport that are fixed for the medium to long term and that inhibit investing instead in green infrastructures or urban 'nature-based solutions'.
- *Institutional settings*: institutions are the "*rules, norms and strategies adopted by individuals operating within and across organisations*" (Ostrom, 2007, in Hegger et al., 2020: 5) and form "*recurrent patterned arrangements which limit the choices and opportunities available, as opposed to agency that is the capacity of individuals to act independently and to make their own free choices*" (Hegger et al. 2020: 5). Institutions that may provide or limit the scope for BPI include mechanisms to hold specific actor(s) accountable for biodiversity action; procedures such as EIA or SEA legislation; a culture of collaboration between public and private actors within a policy sector ('social capital'); the regular evaluation and reconsideration of policies and their outcomes and impacts, which provides space for the consideration of biodiversity targets ('reflexivity' or 'adaptive learning'); and the flexibility or rigidity ('lock-in') of institutions.
- *Discourse*: e.g., the framing of biodiversity recovery as a cost rather than as a benefit, competing discourses that inhibit joint action, etc.
- *Agency*: political or societal pressure, specific actors using their power (or building coalitions to mobilise power) to take biodiversity action (including the deliberate framing of biodiversity recovery as key to achieving sectoral targets).
- *Shock events*: sudden, unexpected events which may come from inside or outside a policy domain and that provide windows of opportunity for change. An example is the 2017 paper reporting on 75% loss in insects in 30 years in German nature reserve areas.

**Coding**

The papers are all relevant in view of the research questions, but do not address all the variables introduced above explicitly (or at all). In addition, some papers provide empirical evidence whereas other papers suggest solutions. Please decide based on the scope of the coded paper, which research questions (and variables) you can code. We suggest:

[2] Hegger, D., H. Runhaar, F. van Laerhoven and P. Driessen (2020), Towards explanations for stability and change in modes of environmental governance: a systematic approach with illustrations from the Netherlands, *Earth System Governance*, 3, 100048.

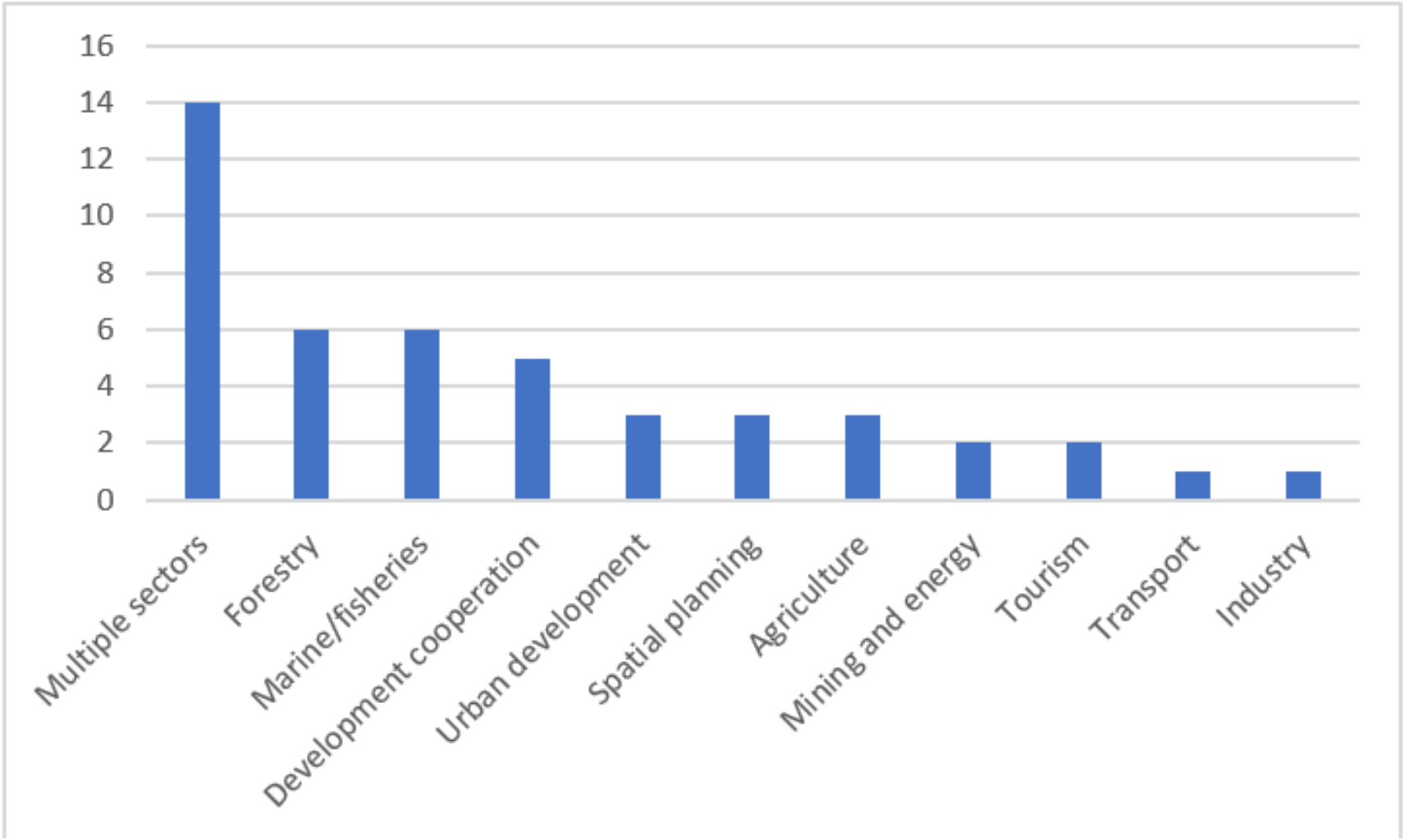
- To code the ‘dependent variable’ as much as possible in quantitative terms (we employ a 3 to 4-point scale), but with a short explanation.
- To code the two sets of ‘independent variables’ by means of a short narrative.

Please only code for the evidence presented in the paper (and not on what you ‘read between the lines’ and/or your own knowledge of the sector at issue). Quotations are very helpful, also because we might have to adapt this to the narrative of the paper and will benefit from having the specific text sections in the article.

To provide an example, we send you our coding of two papers that form part of our Special Issue.

## Annex 4: Descriptive results

- Sectors included in BPI papers
- More detailed findings related to enabling factors and processes


16
14
12
10
8
6
4
2
0
Multiple sectors
Forestry
Marine/fisheries
Development cooperation
Urban development
Spatial planning
Agriculture
Mining and energy
Tourism
Transport
Industry

***Joint Planning***

| *Dimension* | *Specific tools or activities* | *Literature that mentioned it* | *How to assess progress* |
|---|---|---|---|
| ● **Inclusion of diverse value perceptions** | - "boundary objects" or "brokering language"<br>- Indicator and monitoring frameworks (for creating a common language)<br>- Workshops & working groups<br>- Natural capital accounting | Huge et al. 2020a<br>Sarkki et al. 2016<br>Huge et al. 2020b<br>Gomar 2016<br>Pröbstl et al.2023<br>Kumari 1995<br>Zinngrebe 2018<br>Suarez 2023 | - Are inclusive narratives (such as "multifunctionality", " nature-based solutions" or "eco-friendly energy transition") used in the processes?<br>- Are biodiversity values rearticulated to reflect the concerns of stakeholder groups?<br>- Are possible synergies addressed? (e.g., climate & biodiversity) |
| ● **Inclusion of diverse knowledge** | - Transdisciplinary processes | Huntley 2014<br>Sevianu et al. 2021<br>Pröbstl et al. 2023<br>Karlsson-Vinkhuyzen et al. 2018<br>Grima et al. 2017 | - Are pluralistic knowledge streams included in the processes? (e.g., traders and consumers; traditional and modern knowledge; local and international; Developing-Developed countries; biophysical and socio-economic) |
| ● **Co-designing policies** | - inter-institutional and cross-sectoral interactions<br>- cross-sectoral / cross-level working groups among ministries<br>- alignment of monitoring schemes<br>- biosphere & bioregional planning<br>- cross-references in planning processes and agreements | Zinngrebe 2018<br>Friedmann et al. 2018<br>Redford et al. 2015<br>Shih and Mabon 2018<br>Sotirov and Storch 2018<br>Huge et al. 2020b<br>Smith and Wolfson 2004<br>Xie et al. 2022<br>Cardona Santos et al. 2023<br>Diz et al. 2018<br>Barirani 2021 | - Is there a coordination process for jointly developed policies?<br>- Are possible synergies addressed? (e.g., climate & biodiversity) |
| ● **Allocating responsibilities** | - Creation of permanent spaces, such as chambers and councils, that allow a continuous dialogue with affected groups, giving them adequate power in managing, monitoring, evaluating, and reviewing these policies<br>- participative and open arrangements<br>- coordination platforms between actors & institutions<br>- Co-management approaches involving close collaboration between practitioners, scientists, and politicians s, including bottom-up management regimes and the allocation of exclusive access rights to natural resources | Karlsson-Vinkhuyzen et al. 2017<br>Huge et al. 2020a<br>Queiroz-Stein and Siegel 2023<br>Bisht et al. 2020<br>Alblas and Van Zeben 2023<br>Garraud et al. 2023<br>Whitehorn et al. 2019<br>Huge et al. 2020b<br>Gomar 2016<br>Pröbstl et al. 2023<br>Gomar et al. 2014b<br>Brörken et al. 2022<br>Xie et al. 2022<br>Suarez<br>2023<br>Barirani 2021 | - Are responsibilities clarified between institutions, political levels and sectoral actors?<br>- Are specific actors perceived as “envies” for cooperation?<br>- Are efforts framed as a "whole-of-society" and "whole of government" approach? |
| ● **Mobilise specific actors** | - "ideological functionaries" as powerful actors with authority, visibility and credibility have the position to change ideological foundations - integrating them in strategic alliances can help making changes in the "rule of the game"<br>- issue specialists can act as brokers or entrepreneurs between sectors by being involved in various policy processes at the same time. | Reber et al. 2023<br>Karlsson-Vinkhuyzen et al. 2018<br>Holness et al. 2018 | - Are “specific” actors involved in the planning process?<br>- Are the processes supported by them? |

| *Dimension* | *Specific tools or activities* | *Literature that mentioned it* | *How to assess progress* |
|---|---|---|---|
| | - Need for BPI "leaders" (e.g., national governments) with convening power to bring together unlikely groups of stakeholders and stimulate courageous conversations. | | |
| ● **Provision of data & information** | - Free, openly, and effectively available data platforms<br>- Exchange & storage platforms for different stakeholders (e.g., scientists, practitioners, etc.)<br>- Investment into visibility of data platforms<br>- National and global platforms for knowledge distribution | Huntley 2014<br>Huge et al. 2020a<br>Sarkki et al. 2016<br>Moritz et al. 2011<br>Fajardo et al. 2021 | - Are data management platforms set up?<br>- Is data openly and free available for all relevant stakeholders? |
| ● **Secure legal status of processes (e.g., NBSAPs)** | - Inter-ministerial / governmental agreements<br>- reference framework and a control plan defined by law and set by decree | Dik et al. 2023<br>Garraud et al. 2023<br>Gomar 2016<br>Zinngrebe 2018 | - Are BSAPs legally binding? |

**Revising Policies**

| *Dimension* | *Specific tools* | *Literature that mentioned it* | *How to assess progress* |
|---|---|---|---|
| ● **Establishment of Monitoring & Review Processes** | - Long-term monitoring schemes<br>- Monitoring of indirect drivers<br>- Yearly revision of development plans<br>- National accounting<br>- GBIF<br>- Social assessments<br>- Joint projects between institutions | Sarkki et al. 2016<br>Basu 2014<br>Shih and Mabon 2018<br>Siddiqui 2013<br>Moritz et al. 2011<br>Smith and Wolfson 2004<br>Barirani 2021<br>Redford et al. 2015 | - Are regular revisions of plans, strategies or other instruments institutionalised / conducted on a regular basis? |
| ● **Provision of robust data** | - Long-term monitoring schemes | Redford et al. 2015 | - Are the revisions based on sound / robust scientific data?<br>- What sources are consulted for the revision processes? |
| ● **Provision of resources / Recognition of institutional capacities** | - Provision of needed resources (time, financial, personal) | Gomar 2016<br>Zolyomi et al. 2023<br>Huge et al. 2020b<br>Pröbstl et al. 2023 | - Are enough resources provided for the revision of the policies / adapting institutional parameters? |
| ● **Include different political levels & stakeholders in the revision process** | - E.g., rigid and Non-inclusive regulations often curb the rights of indigenous communities. Hence the legal framework must be more conducive to address the primary needs of communities while protecting the sensitive ecozones.<br>- Check instruments at different political levels (e.g., provincial level) | Basu 2014<br>Alblas and Van Zeben 2023 | - Are all affected stakeholders included in the revision processes? |
| ● **Mediation between institutions** | - Overcoming turf battles and competition for resources in international agreements surrounding CBD | Gomar 2016 | - Are mediating mechanisms in place in case of conflicts during revision processes? |

| *Dimension* | *Specific tools* | *Literature that mentioned it* | *How to assess progress* |
|---|---|---|---|
| ● **Secure legal status / mandate of processes (e.g. BSAPs)** | - International mandate / support<br>- National mandate given to process<br>- Support by public society / public criticism<br>- providing a public mandate to integrate NBS in governmental tender and procurement policies<br>- combining hard law with soft law | Pröbstl et al. 2023<br>Siddiqui 2013<br>Xie et al. 2022<br>Sevianu et al 2021<br>Gomar et al. 2014b | - What mandate does the revision process have?<br>- Who leads the processes? |
| ● **Change incentive structures** | - Ecolabel certification | Garraud et al. 2023<br>Kumari 1995 | - Are incentive structures adapted in favour of biodiversity? |

**Adaptive Learning**

| *Dimension* | *Specific tools* | *Literature that mentioned it* | *How to assess progress* |
|---|---|---|---|
| ● **Enabling systematic evaluation & monitoring** | - Long-term evaluations (e.g., a second generation checklist is usually considerably more useful and complete than a first attempt)<br>- clear evaluation of biodiversity performance<br>- headline indicators for BPI, technical guidance, education and aid providers, indicator frameworks<br>- Periodical Global biodiversity information outlook<br>- Natural inventory as reference for assessing future policy adaptations<br>- key indicators and evaluation reports | Dik et al. 2023<br>Redford et al. 2015<br>Alblas and Van Zeben 2023<br>Zolyomi et al. 2023<br>Pröbstl et al. 2023<br>Siddiqui 2013<br>Moritz et al. 2011<br>Smith and Wolfson 200)<br>Xie et al. 2022<br>Cardona Santos et al. 2023<br>Zinngrebe 2018<br>Brörken et al. 2022 | - Are periodically, long-term evaluations and monitoring in place? |
| ● **Enabling knowledge exchange** | - standardised, user-friendly database<br>- providing metadata<br>- central accessibility of background information (e.g., accountability reports on NBS)<br>- engage with multiple knowledge systems (e.g., local farmers, IPLs, practical and theoretical) | Fajardo et al. 2021<br>Sarkki et al. 2016<br>Bisht et al. 2020<br>Simoncini et al. 2019<br>Pröbstl et al. 2023<br>Zinngrebe 2018 | - Are information and knowledge easily accessible for all relevant stakeholders? |
| ● **Include actors in the revision processes** | - Workshops, working groups, model regions, partnerships, etc. with local stakeholders, IPLCs, citizen science<br>- inter-organizational exchange (e.g., CBD <> other related agreements)<br>- catalytic alliances of governmental and non-governmental agents or new institutional arrangements (e.g., intersectoral groups, cross-cutting environmental assessments)<br>- top-down management as problem<br>- "Natural capital project have thus led a campaign to "discredit a status quo (e.g., conservation-as-usual) while presenting "the alternative practices they are championing" (i.e., those syncretized via) (page 1313) [Yves: this resembles the x-curve for views and concepts] - skilful | Bisht et al. 2020<br>Fajardo et al. 2021<br>Simoncini et al. 2019<br>Huge et al. 2020b<br>Xie et al. 2022<br>Suarez 2023<br>Pröbstl et al. 2023<br>Gomar 2016 | - Are different actor perspectives represented in the revision processes? |

| *Dimension* | *Specific tools* | *Literature that mentioned it* | *How to assess progress* |
|---|---|---|---|
| | coordination and deployment of resources - learning through exchange - boundary objects (see above) can facilitate this process<br>- Avoid: asymmetric adjustments along vertical administrative levels by coordination<br>- Enable honest and equal participation formats | | |
| ● **Transform problem definition of actors** | - As precondition for enabling stakeholders to adapt policies<br>- Adapt to national contexts | Queiroz-Stein and Siegel 2023 | - Are problem perceptions of stakeholders changed in favour of biodiversity? |
| ● **Strengthen SPIs** | - evaluations must be adjusted to target problem and audience<br>- the relevance of assessments is conditioned by the science-policy-interfaces they are communicated from - revising institutional settings are central to defining how knowledge enters decision making processes<br>- institutional entrepreneurs can bridge fields and groups and translate across "languages"<br>- increase social science in research<br>- assessments don't reach decision makers directly, but in an accumulated processed way - depend on communication channels and formats, ideological constraints, and interest | Zolyomi et al. 2023<br>Pröbstl et al. 2023<br>Suarez 2023 | - What interfaces exist to transfer scientific knowledge to policy makers?<br>- How frequently are they used by the stakeholders?<br>- What do these formats focus on? |
| ● **Strengthening accountability** | - Exchange formats should focus on the joint planning and implementation of targets than simply reporting of the status quo<br>- societal groups as Fridays for Future as potential supporters of learning and demanding accountability | Pröbstl et al. 2023 | - What is the focus of coordination structures between different decision makers and stakeholders?<br>- Are there any accountability mechanisms (or compensating influences) to guarantee an adaptation? |
| ● **Strengthen the political mandate of biodiversity & institutional flexibility** | - Mandate given to environmental agencies leading processes like NBSAPs<br>- Mandate given to the GBIF<br>- Sectoral institutions are locked into operational customs and historically grown administrative practices | Moritz et al. 2011<br>Suarez 2023<br>Siddiqui 2013<br>Pröbstl et al. 2023<br>Zolyomi et al. 2023 | - What mandate does the adaptation process have?<br>- Who leads the processes? |
| ● **Provide resources for the revision of policies** | - Financial, personal, and organisational resources | Huge et al. 2020b<br>Garraud et al. 2023<br>Moritz et al. 2011<br>Pröbstl et al. 2023<br>Smith and Wolfson 2004 | - Are sufficient financial and personal resources provided to enable the adaptation process? |