

1 ***Recognizing the complex and interwoven role of biodiversity in the Resource Nexus:***
2 ***Signatory Document of the Dresden Nexus Conference 2022***

3

4 **Introduction**

5 Past and present environment and resource management approaches have been
6 inappropriate and short-sighted and have resulted in multiple predictable and unpredictable
7 emergent issues and problems. We now face a biodiversity crisis, a changing climate, food
8 and energy insecurity, rapid urbanization in certain areas, an increased rate of emerging
9 zoonosis with the potential for pandemics, shifting demographics, and development
10 disparities, with social justice consequences.

11 The Resource Nexus concept offers an opportunity to daylight and address these challenges
12 and develop sustainable solutions. This approach takes us beyond looking at individual
13 resources or components and demands holistic consideration of complex systems'
14 functioning, productivity, and management (Hülsmann and Ardakanian, 2018).

15 The Resource Nexus concept presents an opportunity for transformative change by
16 addressing the emergent complex, interrelated resource crises. This emerging and rapidly
17 evolving approach is particularly useful in that it forces us to think about the linkages
18 between social-ecological system components. Social-ecological systems are recognized as
19 complex systems, and the Resource Nexus concept aids in engaging this multifaceted and
20 challenging space. However, the way in which biodiversity has been engaged within the
21 Resource Nexus concept has so far been inadequate. This is backed up by the increasing
22 calls for research on ecosystems and their links to the water energy food nexus, put out by
23 large international funding agencies (Horizon Europe, PRIMA calls: Mediterranean region).

24 This knowledge gap forms the focus of the 2022 Dresden Nexus Conference (DNC 2022).
25 This meeting provided the opportunity to explore the role of biodiversity in the Resource
26 Nexus. Biodiversity is defined holistically as the diversity of species, genetic variation among
27 species, their complex assemblages in ecosystems, their interactions and functions in the
28 environment (Noss 1990), and the differences among habitats.

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30 **Problem statement**

31 Mismanagement, poor planning and inappropriate policy related to our natural resources
32 and landscapes have resulted in multiple linked planetary pressures. Of the approximately
33 eight million animal and plant species known to science worldwide, around one million are
34 threatened with extinction. This loss of biodiversity is one of the greatest threats to
35 planetary function and our long-term survival (IPBES 2018). The state of biodiversity directly
36 impacts us, both individually and collectively, and these impacts are linked to a range of
37 nexus issues. Therefore, the effective operationalization of the Resource Nexus concept
38 requires that we more clearly engage with the underpinning role biodiversity plays in
39 supporting human activity. So far, this role has been largely overlooked. The DNC 2022 has

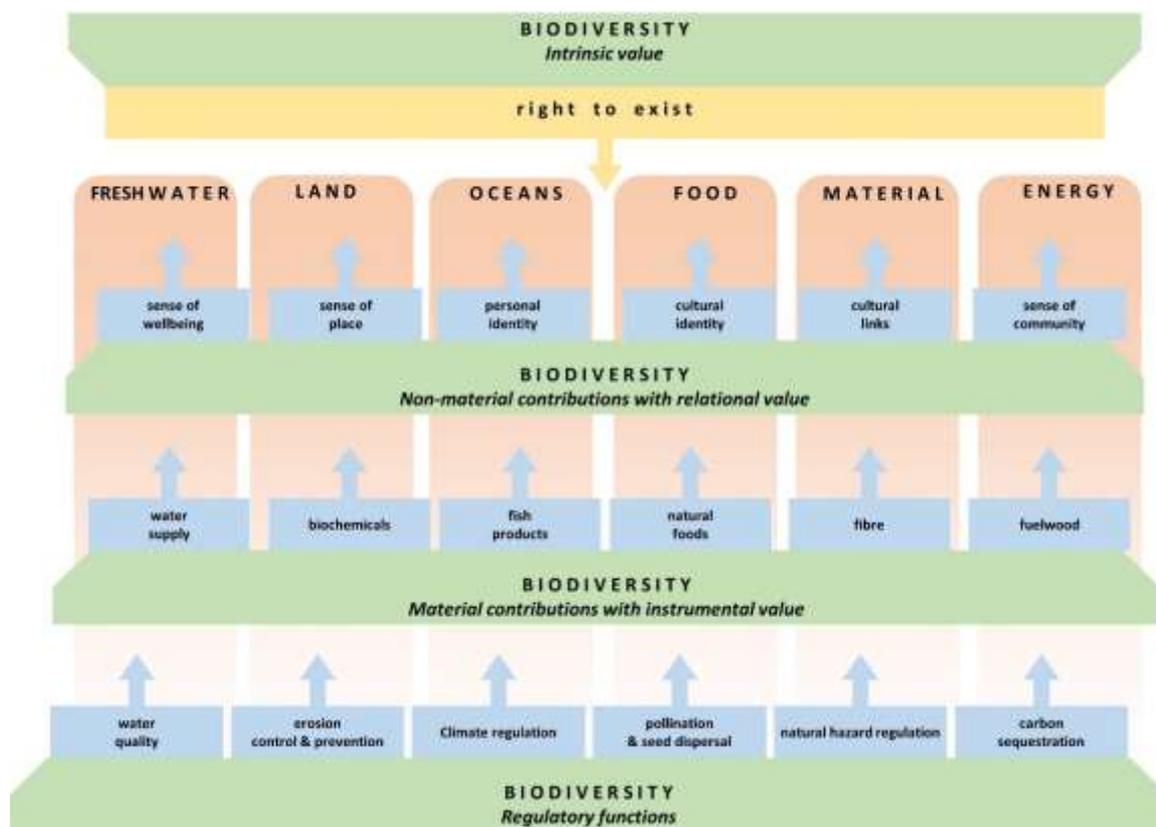
40 specifically focused on the role of biodiversity in the Resource Nexus. Emergent thinking is
41 captured here.

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43 **Clarifying the role of biodiversity within the Resource Nexus**

44 The term “Nexus” in Latin describes the act of tying together or something which binds. In
45 connection with environmental resources management, the term nexus was introduced
46 during the 1980s by the United Nations Universities Food-Energy Nexus programme (Sachs
47 and Silk 1990). However, the Nexus Approach only gained prominence in international
48 academia and policy circles in the lead-up to the Bonn2011 conference on the “Water,
49 Energy and Food Security Nexus”. The conference argued that such an approach could
50 improve water, energy, and food security by integrating “management and governance
51 across sectors and scales”, reducing trade-offs, building synergies, promoting sustainability,
52 and transitioning to a green economy (Hoff 2011). The Resource Nexus has been expanded
53 to include land and materials, and environmental functions have been partially included
54 within the land domain.

55 It is here acknowledged that all critical environmental resources, are at their foundation,
56 comprised of either landscape and/or seascape elements (including, for example, terrestrial,
57 marine, coastal and freshwater features). We also recognize that oceans must be more
58 clearly included in Resource Nexus thinking as a critical environmental resource.
59 Furthermore, freshwater biodiversity elements, critical for water quality and quantity
60 regulation, also need to be integrated into the resource nexus and the concepts of critical
61 environmental resources. Biodiversity and its components, genes, species and ecosystems,
62 in concert with abiotic processes, provide the building blocks of the structure and function
63 of ecosystems and landscapes. These underpin all aspects of the Resource Nexus (figure 1).
64 Biodiversity provides valued regulatory functions such as soil retention for land use,
65 material and instrumental contributions such as fibre for materials, non-material
66 contributions and relational functions where people are afforded the opportunity to have a
67 sense of belonging and community expressed through biodiversity-informed landscape
68 features, and ultimately intrinsic values where nature is valued simply for its existence.
69 These lenses demonstrate how biodiversity operates within and contributes to the Resource
70 Nexus linking across critical environmental resources.



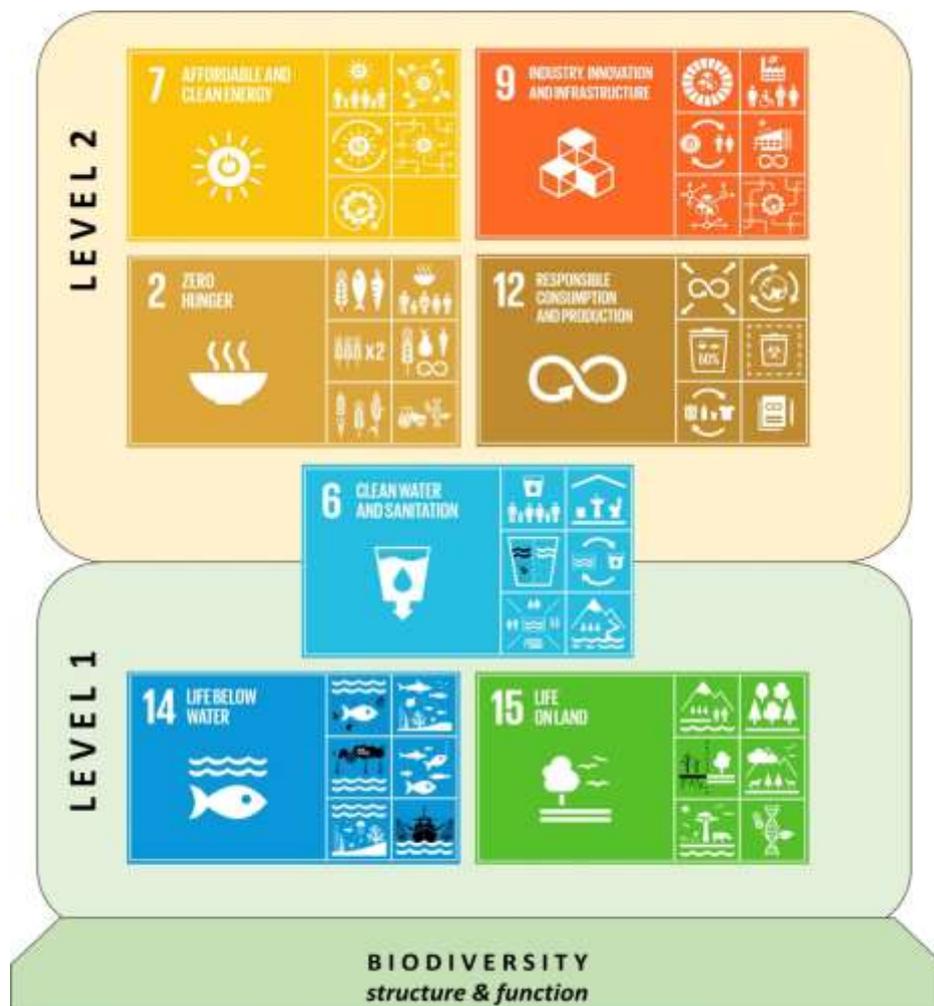
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72 **Figure 1.** The four lenses - regulatory functions, material contributions with instrumental
 73 values, non-material contributions with relational value, and intrinsic values, through which
 74 biodiversity support within the resource nexus is evident.

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76 Acknowledging that biodiversity plays an underpinning role in the Resource Nexus,
 77 regulating and resourcing, it becomes imperative to revisit the representation of the nexus
 78 (figure 2). Previous representations have placed all domains / critical resources on a single
 79 level or at the same level. Emerging understandings suggest that a hierarchical approach
 80 that positions biodiversity as enmeshed among the land, ocean and freshwater elements
 81 sits as an underpinning feature to the identified domains such as energy, food and
 82 materials. This more integrated and layered conceptualization allows for a better
 83 understanding of the tensions and drivers within the Resource Nexus and can enhance
 84 management (Bleischwitz et al. 2018). Taking this thinking to the national and global scales
 85 may allow for more effective engagements toward achieving the SDGs. According to this
 86 layered approach, these could be reorganized to better demonstrate linkages and enhance
 87 their collective achievement. When viewed from this hierarchical perspective, awareness of
 88 the trade-offs or synergies becomes clear.

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90

91 **Figure 2.** A hierarchical basis for approaching the Resource Nexus interactions given the
 92 foundational aspects of biodiversity. Biodiversity aspects need to be considered as primary
 93 in unpacking Resource Nexus linkages.

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95 **Building future Resource Nexus research directions – emergent conference messages**

96 Contributions and emerging work from the Dresden Nexus Conference 2022 highlight three
 97 clear directives, focused on research needs, developing novel approaches and partnerships
 98 for advancing our understanding of the role of biodiversity within the Resource Nexus.

99 **1) Research needs**

100 While much understanding has already been achieved, we still have considerable work to do
 101 in reimagining the role of biodiversity within the Resource Nexus. Whilst elements of this
 102 are highlighted above, the role of biodiversity as an underpinning for all environmental
 103 resource-related activities requires considerable further attention and integration. This
 104 conference has highlighted the need for broadening the Resource Nexus habitat, for
 105 example, with the inclusion of current work on oceans and ocean biodiversity.

106 This in turn reminds us of the importance of scale and that further research is required
107 across all the biodiversity hierarchical scales from local to global. Being cognisant of spatial
108 and temporal scales will be critical in aligning conservation with sustainable resource use.
109 Taking resource nexus thinking into all realms of resource use and conservation will likely
110 highlight critical trade-offs, giving more accurate depictions of the costs and benefits, who
111 the winners and losers are under different scenarios, and where conflicts will arise. Past
112 understandings, that have emerged from more siloed approaches may need to be re-
113 examined. These insights will allow for more just and equitable management and decision-
114 making.

115 Presented research suggests that governments have tended to adopt a lowest cost and
116 short-term approach to resource management. The full implications of management and
117 regulations, for example, on ecosystem structure and composition, need to be better
118 understood. Particular attention will need to be paid to human wellbeing, social inequality,
119 and gender in resource access and distribution in all future research.

120

121 **2) Novel approaches**

122 In working toward sustainable development and meeting Agenda 21 commitments, we
123 need to develop and adopt novel approaches, both in management and advancing our
124 understanding through research. Novel frameworks are emerging that provide decision-
125 makers with the tools to better understand and manage nexus issues, particularly within the
126 food water energy nexus. Truly forward-looking frameworks have transformative change at
127 their core and adopt a self-reflective approach through iterative engagement that reflects
128 on learning. There is also growing recognition of the value in adopting a plurality of
129 approaches in generating understanding, for example integrating economic, social, health
130 and ecological methods and co-developing this research with a diversity of stakeholders.

131 Advances in technology also present new opportunities for both research and industry. New
132 technologies and production strategies are being developed to reduce the use of raw
133 material, reduce industry impact on ecosystems and/or manage waste. Improved
134 technology in remote sensing and processing capacity continues to allow us to work at finer
135 resolutions and build more complex models for building nexus understanding.

136 Green infrastructure approaches and the associated instrumental value of biodiversity,
137 position nature at the centre of development. Green infrastructure as an emerging
138 paradigm for development becomes more prominent as we further understand the climate
139 change, urbanization, biodiversity nexus and the need to mitigate both risk and impacts of
140 change. This approach also allows for insights into relational values, showing the links
141 between human wellbeing, physical and mental health, and biodiversity, particularly in
142 urban settings.

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144 **3) New partnerships**

145 Novel partnerships are instrumental in resolving tensions and trade-offs across the Resource
146 Nexus. Successful partnerships must emerge based on trust, most likely achieved through
147 extensive dialogue and identified commonalities. These partnerships are required between
148 scientists and policymakers, strengthening the science-policy interface and across the
149 associated disciplines. Here, transdisciplinary approaches are vital for understanding the
150 role of biodiversity in the resource nexus, providing data and scientific evidence needed to
151 enhance the development of theory and pragmatic management approaches. Bottom-up
152 approaches, inclusive of or led by stakeholders, also appear to drive the alignment of
153 legislation and regulation of resource management.

154 The development of carefully considered locally developed guidelines and best practice
155 guides also have much to offer in promoting unbiased decision-making. These tools and
156 approaches are valuable in content and development, where stakeholder groups co-develop
157 these products. This, however, may require capacity building to ensure that all actors are
158 equally empowered. Furthermore, these products need to be mainstreamed across all levels
159 of decision making. Successful partnerships are mindful of intersectionality and engage
160 issues around gender and inequality.

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