



Task Force 6
Accelerating SDGs: Exploring New
Pathways to the 2030 Agenda



THE ROLE OF GREEN INFRASTRUCTURE IN BIODIVERSITY CONSERVATION

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Abstract



Infrastructure is at the heart of the G20's efforts to strengthen the structural foundations of global development, make it more sustainable, and mitigate its negative effects. Infrastructure may have a variety of effects on biodiversity, including direct habitat loss within the footprint of existing infrastructure, changes in ecosystem characteristics, and fragmentation and deterioration of biological resources. Green Infrastructure (GI) is a strategy that has been offered as having the capacity to address these challenges,


and its implementation is a means to restore natural patterns and processes, and minimise energy and material flows. Without proper environmental regulations, GI development undermines global biodiversity and ecological services. In new urban development projects, sustainable construction should entail low-carbon buildings and GI. Biodiversity in urban development plans enhances health; governments must educate, empower, and encourage developers/builders and communities to integrate green built environments into their landscape.



The Challenge



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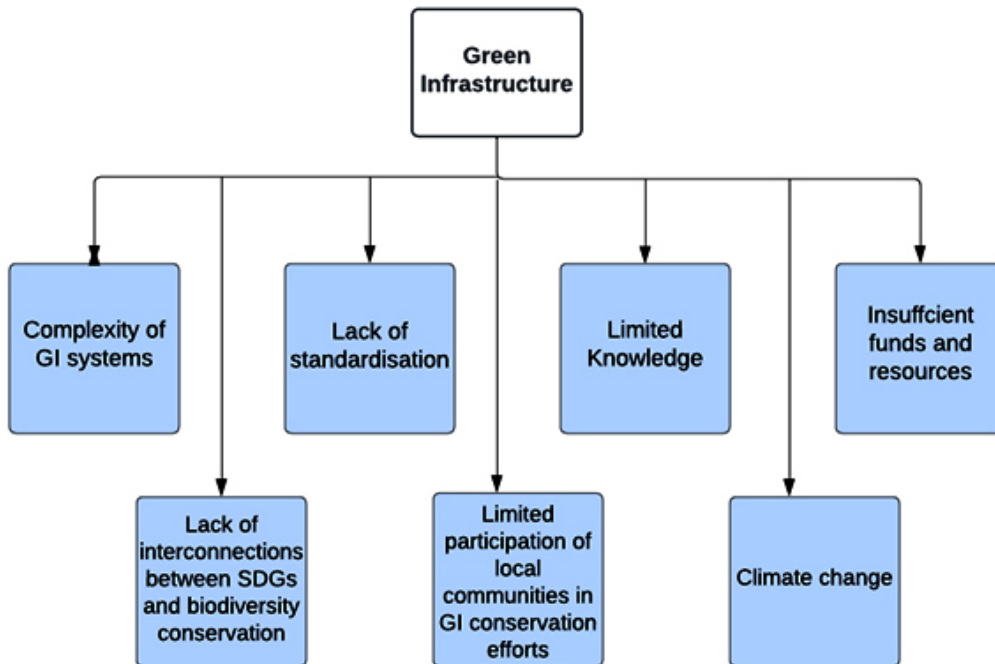


Biodiversity is essential for the health and resilience of ecosystems and human well-being. However, anthropogenic activities threaten biodiversity through habitat destruction, pollution, and climate change. In this context, green infrastructure (GI) emerges as a nature-based solution to conserving and restoring biodiversity. GI, comprising natural and semi-natural elements, such as parks, forests, wetlands and green spaces, offers a range of ecological services that support diverse species and ecosystems. To effectively manage infrastructure and support biodiversity conservation, the G20 must implement a national as well as a global sustainability strategy.

In assuming the G20 presidency, India has the unique opportunity to continue the grouping's progress on developing

a global green infrastructure agenda. A number of notable global agreements have been implemented to promote biodiversity conservation. Despite these agreements, however, degradation and loss of biodiversity continues. Pollution, overexploitation of species, climate change and, most significantly, increasingly fragmented landscape mosaics consisting of isolated and degraded ecosystems, are further fuelling biodiversity loss. All these negative forces thrive on intensive extraction of natural resources and land use change to sustain existing development and consumption patterns. According to estimates, biodiversity loss has already surpassed humanly tolerable levels, leading to far-reaching consequences for human development (Salomaa, Kettunen, and Apostolopoulou 2016). Figure 1 depicts the obstacles that impede adoption of GI.

Figure 1: Challenges Influencing Adoption of GI




Source: Authors' own

Multiple kinds of construction activities—from large-scale infrastructure projects to modest house renovations—impact natural ecosystems, making the construction sector a crucial player in averting biodiversity loss. GI is any kind of infrastructure that aims to reduce the negative impacts of development and/or offer ecological services, such as runoff management, air temperature reduction, carbon sequestration and habitat preservation. GI has not been widely adopted despite these potential benefits (Tayouga and Gagné 2016).

The rate of mainstream adoption has been slow because of the upfront

costs of design and construction and the necessity to conserve natural systems. Additional impediments include inconsistent legal frameworks, lack of community participation, and the perception that GI is primarily a tool for stormwater control (Anderson and Gough 2022).

Eighty percent of the world's population live in urban areas, necessitating expansion of urban infrastructure amenities, including zones for industry, commerce, residences, and recreation. Parks, playgrounds, water bodies, residential gardens, courtyards and highways are the essential components



of GI that link people with nature. GI encompasses green buildings and its key techniques include those pertaining to storm water management, decreased heat stress, climate adaptability, enhanced air quality, sustainable development, clean water and healthy soil, and improvement in quality of living. When sustainable transportation and drainage systems are addressed, urban green infrastructure (UGI) can also refer to “low-carbon infrastructure” (Patel and Rangrej 2021).

The next challenge involves determining how to incorporate the biodiversity value of new construction and renovation projects into UGI to analyse and design a strategy for promoting biodiversity on project sites to improve living standards. Municipal and national-regional scales utilise GI differently. The town scale consists of district parks, playgrounds, neighbourhood parks, green belts (buffers), urban canals, lakes, rivers, and floodplains. The participation of public and private enterprises varies

across towns and countries, thereby posing challenges attributed to non-standardisation of notions.

In addition to the aforementioned obstacles, lack of understanding of the ecosystem services provided by GI, which are crucial for the development of sustainable cities, also impedes adoption of green infrastructure.

Incorporating biodiversity into the development of GI is key to accomplishing the Sustainable Development Goals (SDGs). Correlations between SDGs 9 (resilient infrastructure, inclusive and sustainable industrialisation and innovation), 14 (sustainable use the oceans, seas and marine resources), 15 (sustainable use of terrestrial ecosystems and forests, halt and reverse land degradation and biodiversity loss) and other SDGs are often dismissed or neglected (Opoku 2019). Table 1 shows the gaps and the potential SDGs related to the adoption of GI.

Table 1: Alignment of Relevant UN SDGs

UN SDGs	Corresponding UN SDGs	Gaps	Relevant studies
SDG 9 (Industry, Innovation and Infrastructure)	SDG 2 (Zero Hunger) Target 2.A – invest in rural infrastructure. SDG 12 (Responsible Consumption and Production) Target 12.2 – sustainable management and use of natural resources	<ul style="list-style-type: none"> • Policies must be implemented to assist women’s employment through rural infrastructure development. • Abstain from the use of materials, which produce CO₂ and result in greenhouse gases (GHGs). 	(Opoku 2019); (Omer and Noguchi 2020)
SDG 14 (Life below Water)	SDG 7 (Affordable and Clean Energy) Target 7 A – promote access to research technology and investments in clean energy. SDG 9 (Industry, Innovation and Infrastructure) Target 9.4 – upgrade all industries and infrastructure for sustainability.	<ul style="list-style-type: none"> • The development of renewable energy technologies, such as offshore wind and wave energy, can have a significant impact on marine ecosystems. • The development of ports, coastal infrastructure and shipping lanes can have a significant impact on marine ecosystems. 	(Ronzon and Sanjuán 2020); (Recuero Virto 2018)
SDG 15 (Life on Land)	SDG 6 (Clean Water and Sanitation) Target 6.1 – safe and affordable drinking water SDG 11 (Sustainable Cities and Communities) Target 11.3 – inclusive and sustainable urbanisation	<ul style="list-style-type: none"> • All-natural land that supplies clean water to downstream communities must be sustainably maintained. • Reducing the negative impact of urbanisation on terrestrial ecosystems and biodiversity 	(Mulligan et al. 2020); (Vargas-Hernández and Zdunek-Wielgołaska 2021)

Source: Authors’ own

Aligning financial systems with sustainable development is another challenge. Significant obstacles to infrastructure investment, which must be addressed, include

inadequate national strategies and capacities; fragmented international frameworks; lack of connectivity; inadequate standardisation, efficiency and transparency in processes and

methodologies; and considerable related financing/governance issues (Atkinson et al. 2019).

GI is a proposed approach that can resolve these issues. The present conceptual ambiguity of GI, along


with the complicated functions of its ecosystem services (and the likely interpretation of this in practice) raises concerns about its capacity to contribute to biodiversity conservation despite its potential for promoting biodiversity.



The G20's Role

2





Under India's presidency, the international community may focus on the 4Ds: **de-escalating** conflicts; boosting **digitalisation** to allow quick, equitable and inclusive **development**; and adopting an equitable framework for **decarbonisation** to address the climate crisis. Inclusiveness and sustainable growth remain top priorities.

A number of G20 countries have already taken measures to align their laws and policies with sustainable development and mitigate risks associated with GI to preserve biodiversity (Box 1). Given the diversity of laws and policies across the G20, measures must be customised to the particular requirements and conditions of each country.

Box 1: Examples of Green Infrastructure Measures Taken by G20 Countries

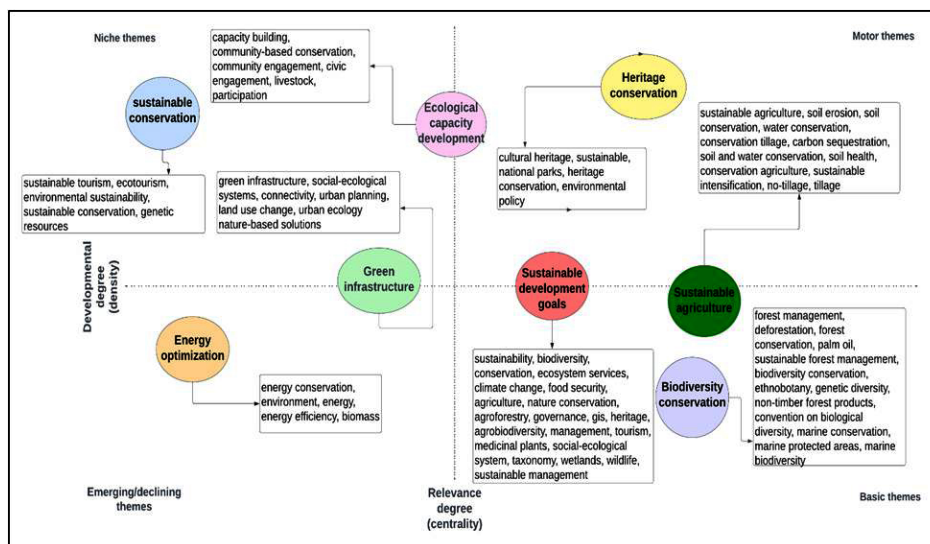
- Brazil: A bilateral collaboration between Brazil and the UK aims to increase sustainable infrastructure investment and facilitate development of projects for reducing inequality and promoting gender equality.
- China: The People's Bank of China has introduced green bond standards and green banking regulations.
- France: As part of the country's Resilience and Recovery Plan, the French government allocated specific measures for fostering green mobility. It is investing 550 million euro in developing transport infrastructure in line with a sustainable transport sector.
- Indonesia: The Indonesian Ministry of Finance has already issued eight green and sustainable bonds, which are helping in the development of its green bond market infrastructure.
- India: The Union Budget 2023-2024 laid the foundation for green infrastructure. Green growth, including green energy, green buildings and green equipment, was one of the seven areas of focus that act as the government's *Saptarishi* (Seven pillars), directing India's *Amrit Kaal* journey (Sustainable future).
- The United Kingdom: Natural England has announced the Green Infrastructure Framework (GIF), which will help raise the amount of green cover in urban residential areas to 40 percent.
- Germany: On 3 June 2020, the German government announced a new economic stimulus programme worth 130 billion euro. It contains a number of robust initiatives for promoting green recovery and low-carbon economy in Germany.

Existing Knowledge in GI and Biodiversity


Figure 2 represents the relevant themes of a conceptual structure. Centrality and density are the two fundamental parameters for understanding thematic maps (Cobo et al. 2015). The level of connection created by a certain theme with others is represented by *centrality* while the magnitude of the internal correlations within the themes is indicated by *density* (Bamel, Umesh, Pereira, Vijay, Del Giudice 2021). Figure 2 is a thematic mapping of the knowledge available in GI and biodiversity, explaining which themes are prevalent in which quadrant.

Heritage conservation appeared as the main theme, with high centrality and density; sub-themes, such as cultural heritage, environmental policy, sustainability and national parks, are all interconnected. It shows that GI can play a key role in enhancing the conservation and valorisation of urban heritage, which is often at risk due to urban development pressures. By incorporating GI features, such as urban parks and green roofs, into historic sites, it is possible to increase their resistance to climate change, minimise urban heat island effect, and increase biodiversity.

Figure 2: Thematic Mapping of the Knowledge in GI and Biodiversity



Source: Web of Science database




GI may also contribute to the cultural and aesthetic value of historic monuments by providing tourists and residents with pleasant and functional spaces. However, design and execution of GI projects in heritage regions must take into account their unique historical and cultural significance as well as the needs and aspirations of local residents (Williamson 2003). Sustainable conservation (niche theme) indicates that the sub-themes are being explored extensively, as evidenced by the literature. Its sub-themes, such as sustainable tourism, ecotourism and environmental sustainability, have been highlighted by how a shift in focus – from the dominant product orientation in environmentally sustainable tourism to a demand orientation – has been proposed to mitigate the inherent tradeoffs between maximisation of profit and investment in environmental sustainability in the tourism industry.

The success of such a strategy depends on the presence of a class of visitors, who are not only motivated to care for the natural surroundings of the host place, whether travelling in an ecotourism or general tourism context, but also constitute an economically appealing market segment (Dolnicar and Long 2009).

In the bottom left and right corners, there are two themes that are partially overlapping with the niche, emerging and motor themes. We see GI, which is approaching the niche theme, or we can be neutral because it has both negative density and negative centrality. But sub-themes, such as social-ecological systems, urban planning and nature-based solutions, have a lot of potential as the extant literature reveals a significant gap in current development of green infrastructure. Therefore, GI needs a significant transformation that takes environment and social standards into consideration to effectively and efficiently match the global sustainable standards. The other theme, ecological capacity-building, is based on a study of communities and their engagement in conserving environment through a network of groups and projects (Jerome 2017).

Energy optimisation is another key theme that has evolved as an independent theme with a low density value. The basic theme quadrant has three themes; biodiversity conservation, sustainable agriculture and sustainable development goals, progressing towards the motor theme. Within the



sub-theme of sustainable agriculture, there is low density and potential for further development. In addition, the SDGs have given renewable energy a tremendous boost and an opportunity


for innovation and development (Brazovskaia, Gutman, and Zaytsev 2021). The thematic evolution map further helps scrutinise the gaps and study the areas that are unexplored.



Recommendations to the G20

3





Biodiversity loss affects not only living creatures, but also the environment, the economy and communities.

This Policy Brief focuses on four broad areas which are universally relevant and a cause of concern. These include developing and implementing standardised assessment methods and materials for GI and enforcing adaptive management strategies for GI conservation; generating and promoting a market for green investment at the global level; increasing public awareness and education regarding GI and its significance for biodiversity conservation; and encouraging collaboration and partnerships among relevant stakeholders.

Developing and implementing standardised assessment methods and materials for GI and enforcing adaptive management strategies for GI conservation.

Biodiversity is related to all sustainable building criteria (energy, water, health and well-being). Therefore, biodiversity schemes should go beyond setting aside natural habitats to include

community education about the built asset and the conserved environment during the in-use/occupancy phase of a project. Loss of biodiversity due to construction impacts not only plants and animals, but also the ecosystem's ability to safeguard constructed assets against climate change-induced floods, landslides and wildfires.

Encouraging GI as a nature-based tool to re-build more effectively and boost climate resilience offers an opportunity of designing a centralised approach that integrates several GI policy instruments. An environmental regulatory effect assessment enables identification of gaps, elimination of inconsistencies and development of a coherent, strategic and integrated environmental policy for nature-based solutions. Use of green technologies, such as wind turbines and solar panels, as alternative energy sources will help reduce carbon emissions and also lead to energy efficiency.

The G20 should promote standardisation of green practices. For example, each city's biodiversity parks are self-sustaining. Starting with the G20, countries should ensure that a fixed number of biodiversity parks are maintained in every city, according

to a standard criterion. Governments should prioritise incorporation of GI into urban and regional planning, formation of ecological corridors, protection and restoration of wetlands and creation of green jobs to support healthy ecosystems and human well-being in a sustainable manner.

Generating and promoting a market for green investment at the global level

Green investment includes both public and private investment. The G20 can establish green investment funds that leverage public and private sector capital to boost GI development. These funds can target specific areas, such as renewable energy, sustainable agriculture or biodiversity conservation. To mobilise financing for GI projects in underdeveloped countries, the G20 can encourage international cooperation on green investment by boosting public–private partnerships and participation among multilateral development banks.

Green bonds have emerged as a new form of environmental financing and have shown great potential for raising funds for conservation projects that help preserve biodiversity and GI. By offering tax incentives, subsidies or


other types of support, the G20 nations may stimulate private sector investment in green bonds for GI projects. This can encourage private sector investment and minimise the cost of financing global initiatives. The countries within the G20 can support certification of green bonds (by regulatory bodies) such as the Climate Bonds Initiative. This can help in ensuring that green bonds meet specific environmental requirements and provide investors with better transparency.

Increasing public awareness and education regarding GI and its significance for biodiversity conservation

The G20 countries may educate residents and stakeholders about GI's benefits and role in biodiversity conservation and sustainable development through public awareness initiatives. These campaigns can use social media, TV, radio and print. Public dialogues, workshops and community meetings can also help educate people about GI projects.

Encouraging collaboration and partnerships among relevant stakeholders

The G20 countries may establish multistakeholder platforms for



government agencies, commercial sector organisations, civil society groups and local communities. These platforms enable stakeholders to communicate, coordinate and share ideas, expertise and resources.

Current global challenges include energy and food security and

affordability, reviving and re-building domestic economies, and various forms of inequity. Aligning policies for environmental preservation, economic development and social equity is now more crucial than ever, if the 2030 deadline for the SDGs and the Paris Agreement objectives are to be met.

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