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Anticipate, Innovate, Transform



**Connecting Business Strategy to
Biodiversity Preservation**

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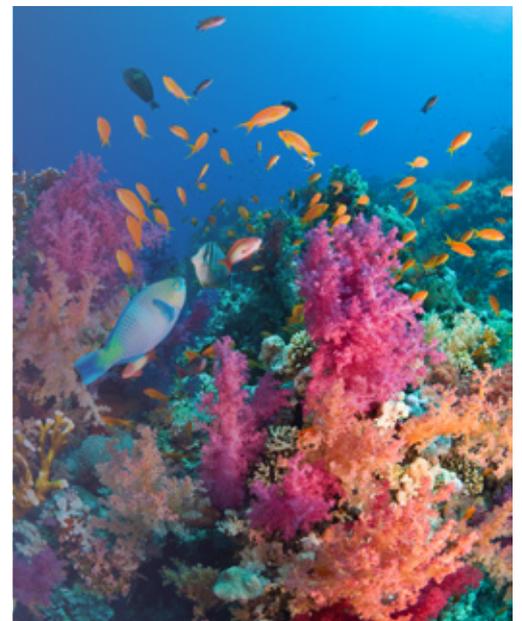
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CONNECTING BUSINESS STRATEGY TO BIODIVERSITY PRESERVATION

**BY KERRIGAN UNTER, LEO VOGEL,
AND JUDITH WALLS, GUEST EDITORS**

Human activity is driving biodiversity loss at a scale so large and rapid that we are in the midst of the sixth period of mass extinction. In fact, since 1970, we have seen a nearly 70% drop in animal populations, and more than a million species are under threat of extinction.¹ This pressure on nature is compounded by rising global temperatures due to climate change.²

The topic of biodiversity loss has, until recently, been mostly of concern to scientists. Business leaders are not well informed about biodiversity, as P.J. Stephenson and Judith Walls discussed in their recent *Amplify* article, “A New Biodiversity Paradigm for Business.”³ Nevertheless, biodiversity loss is a serious business issue. Business activity depends on and impacts biodiversity both directly and indirectly. Biodiversity represents both a source of business risk and an opportunity for value creation.

Biodiversity is the variety of living organisms from genes to species to ecosystems.⁴ Declines in biodiversity negatively affect ecosystem services — services that the Earth provides “for free” such as food; water and raw materials; basic soil formation and photosynthesis; regulation of climate, air, and water; pollination of crops; and cultural value through beauty, spirituality, and recreation. All these affect business operations.

Businesses and policy makers are paying increasing attention to biodiversity. At the recent *Conference of the Parties (COP 15)* in Montreal, Canada, the Global Biodiversity Framework called for extensive conservation and restoration of land and water ecosystems. The framework also places demands on business with goals to reduce risks from chemicals and pesticides by 50%, phase out subsidies that harm biodiversity, cut global food waste in half and reduce overconsumption, and raise financial flows for developing and vulnerable countries. It will require large transnational companies and financial institutions to monitor and disclose their risks, dependencies, and impacts on biodiversity — not only in their own operations, but also across supply chains and portfolios.

In short, the framework highlights the important role of business to maintain, protect, and regenerate nature. Businesses can address biodiversity loss through nature-based solutions that also help mitigate climate change and meet the United Nations (UN) Sustainable Development Goals (SDGs). Nature-based solutions are actions taken to “to protect, sustainably manage, and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.”⁵

Business is slowly moving in the direction of tackling biodiversity loss. Plenty of voluntary, nonfinancial reporting processes already include aspects of nature-related disclosure. As pressure on companies rises to address the risks to biodiversity, businesses will need to develop ways to measure, monitor, and manage their impact on nature.

Businesses face several challenges when embedding biodiversity into their strategies. First, they typically lack knowledge about biodiversity and how it relates to business activities, a gap that is difficult to overcome as business education rarely includes biodiversity. Second, financial, technical, and human resources to address biodiversity issues can be difficult to find. Third, although nature-based solutions can help combat climate change, there can also be trade-offs between what benefits climate change and what benefits biodiversity.

IN THIS ISSUE

This issue of *Amplify* focuses on practical solutions for businesses seeking to address biodiversity loss and regenerate nature. We invited authors to explore two questions. First, how can businesses address current failures to protect biodiversity? Second, what knowledge and resources are necessary to change business activity that impacts the health of ecosystems?

The authors seek to answer these questions and help businesses in various industries put solutions in place. The first group of articles discusses using language to bring nature to the forefront of business decisions, leveraging stakeholder engagement to encourage democratic approaches to biodiversity action, and using circular economy (CE) principles to address biodiversity. The second group of articles centers on industry examples to highlight trade-offs between climate change solutions and biodiversity.

LINKING BIODIVERSITY TO BUSINESS ACTION

Anna Heikkinen, Ari Jokinen, and Johanna Kujala kick off the issue by exploring how nature positive language provides a useful instrument to drive business action on biodiversity issues. They examine how language is critical for developing nature-based stakeholder engagement and illustrate how it can motivate companies to take actions on biodiversity. The authors conclude with descriptions of the benefits nature-based stakeholder engagement can have for businesses, local communities, and the environment.

BUSINESSES FACE SEVERAL CHALLENGES WHEN EMBEDDING BIODIVERSITY INTO THEIR STRATEGIES

Next, Simon Pek and Nicholas Poggioli look at how businesses can learn about biodiversity issues and incorporate them into effective strategies through mini-publics. Mini-publics gather a wide range of stakeholders to deliberate and provide recommendations on addressing an issue. Pek and Poggioli describe how mini-publics can be initiated, their key components, and the benefits they offer for business strategy formulation and implementation. They also look at how businesses can implement mini-publics in a responsible manner and ensure a deliberative democratic process.

In our next article, returning *Amplify* authors Paul Dewick and Joseph Sarkis emphasize the important role the circular economy has in protecting biodiversity. They begin by presenting business strategies for circularity and extending these to consider biodiversity. CE business models draw attention to the importance of reducing waste and pollution, reusing and recycling materials, and regenerating natural systems. The models focus on the strategies of narrowing, slowing, closing, and regenerating/restoring and show how circularity can advance biodiversity protection. Dewick and Sarkis provide practice-oriented guidelines for implementing circular strategies and discuss how enabling factors like IT support, stakeholder engagement, and measurement are important for facilitating circular strategies that protect biodiversity.

PROTECTING & REGENERATING NATURE IS A COMPLEX PROCESS THAT REQUIRES BUSINESSES TO COLLABORATE

BUSINESS & BIODIVERSITY IN PRACTICE

In his article, Rafael Sardá examines the potential of offshore wind farms and the challenges of balancing climate change mitigation with biodiversity protection goals. Significant advances in technology and expanded government support have led to increased development of offshore wind farms. But Sardá cautions that large-scale renewable energy projects should be planned and implemented with biodiversity considerations embedded, so that one environmental goal is not sacrificed for another. He proposes a way to balance protecting marine areas with promoting nature positive strategies.

Finally, Stefania Pizzirani, Robert Newell, Alesandros Glaros, Saeed Rahman, and Lenore Newman explore vertical farming as a pathway to biodiversity conservation. They provide three guiding principles for how vertical agriculture can conserve biodiversity: (1) diversification in produce, (2) localized, decentralized farming, and (3) integration with other social, economic, and physical systems. The authors then apply these principles in practice across several business models in vertical agriculture. They conclude by describing how management practices, complementary technologies, and policy collaboration are key to successful vertical farm implementation.

Protecting and regenerating nature is a complex process that requires businesses to collaborate with local communities, government authorities, and nongovernmental organizations. This issue of *Amplify* shows how businesses can link their practices to biodiversity conservation and regeneration, with examples of how this might look in two industries.

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LANGUAGE IS KEY TO CATALYZING BIODIVERSITY ACTION IN BUSINESS

Authors

Anna Heikkinen, Ari Jokinen,
and Johanna Kujala

The business sector, in collaboration with various stakeholders, is instrumental in providing resources and solutions to address the biodiversity crisis. Biodiversity is declining at an alarming rate, and the costs of inaction — compromised organizational legitimacy and reputation, raw-material shortages, and intensified ecological crises — are increasing. The global community has called for immediate widespread action to “bend the curve” of biodiversity decline.¹

There is increasing evidence of global biodiversity decline. This is alarming given that, according to the World Economic Forum, more than half of global GDP is highly or moderately dependent on ecosystem services, and businesses are more dependent on nature than was previously thought.²

Businesses control substantial resources and knowledge that can, and must, be harnessed for biodiversity action. Business’s response to biodiversity decline has the power to accelerate activities across our societies or, through inaction, hamper societal responses.

**THERE IS STRONG
EVIDENCE
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FRAMEWORKS
THAT ENABLE
HARMONY
WITH NATURE**

There is strong evidence of positive movement, including societal transitions and frameworks that enable harmony with nature. Businesses are now involved with numerous multi-stakeholder networks that aim to develop solutions to thorny sustainability issues, and nature positive language is becoming more commonplace in business.³ Focusing on what’s possible and amplifying positive steps are of utmost importance to implementing change on a short timescale.

We suggest that new phrases are needed to catalyze biodiversity action. The term “nature-based stakeholder engagement” is discussed in this article as a potential candidate, as it connects two powerful notions. “Nature-based solutions” include actions that both protect natural ecosystems and enhance social well-being.⁴ “Stakeholder engagement” refers to the inclusion of stakeholders in organizational practices.⁵ Thus, nature-based stakeholder engagement highlights nature as a focal issue for engagement *and* the need to include a wide variety of stakeholders in nature-enhancing practices like biodiversity protection.

NEW PHRASE PROMOTES KEY CONNECTIONS

Recent sustainability research shows that certain types of language, fresh vocabulary, and attractive metaphors are extremely helpful in initiating and boosting collaborative action for sustainability transformation.⁶ (Note that we’re using the term “metaphor” in the Aristotelian sense: a perception of the similarity in the dissimilar.)

It's time to look closely at the role of language in creating vocabulary with sufficient weight and practical relevance to catalyze biodiversity action in business-stakeholder networks.

We believe the term "nature-based stakeholder engagement" has the potential to establish a connection between regenerating nature, nature-based solutions, and the business sector and to initiate biodiversity action in business-stakeholder networks.

We argue that this phrase is impactful and meaningful because it derives from terms that are part of different discourses: stakeholder engagement and nature-based solutions. Stakeholder engagement is an established construct in management and strategy, as well as in environmental management research and practice.⁷ The phrase "nature-based solutions" is widely used in environmental practice and policy making.⁸

Thus, the concept of nature-based stakeholder engagement transfers "nature" into the domain of business management and stakeholder collaboration and gains power through the interaction and the entangled association of two established discourses.⁹ This type of vocabulary has the potential to create a bridge between academic and practitioner communities.

FRAMEWORKS GUIDING BIODIVERSITY ACTION IN BUSINESS

Debates about biodiversity decline have spurred a variety of frameworks guiding biodiversity action. The terms "regenerating nature" and "nature-based solutions" have recently gained traction in policy making.

The term "regenerating nature" has a high amount of international appeal. Regeneration refers to a natural process that can be assisted or managed and that facilitates ecosystem recovery. The term has become associated with current discussions on ecological restoration, biodiversity, and the circular economy.^{10,11} For example, the European Union (EU) has proposed the Nature Restoration Law, the first-ever legislation targeting ecosystems, habitats, and species restoration across the EU.¹²

Nature-based solutions is another practice with a biodiversity focus that has been successfully promoted by the EU.¹³ Nature-based solutions are actions to protect, sustainably manage, and restore natural and modified ecosystems. At the same time, they address societal challenges and enhance the well-being of people and nature.¹⁴

TERM	DEFINITION
Biodiversity, biological diversity	The variety of living organisms in terrestrial, marine, and other ecosystems. It includes diversity within species, between species, and of ecosystems. ¹
Nature-based solutions	Actions that simultaneously protect, sustainably manage, and restore natural and modified ecosystems as well as enhance social well-being. ²
Nature-based stakeholder engagement	The inclusion and voluntary participation of stakeholders in nature-enhancing practices, such as biodiversity protection or ecosystem restoration. Highlights nature as a focal issue for engagement.
Nature positive	A global aim of halting and reversing nature loss by 2030 and achieving full recovery by 2050. ³
Regenerating nature	A natural process that can be assisted or managed. It enhances resilience, supports local biodiversity, and supplies multiple ecosystem goods and services. ⁴
Stakeholder	Any individual or a group that can affect or be affected by organizational objectives. ⁵ Non-humans, such as animals and plants, can also be considered stakeholders. ⁶

¹ "Article 2. Use of Terms." The Convention on Biological Diversity, 2 November 2006.

² "What You Need to Know About Nature-Based Solutions to Climate Change." The World Bank, 19 May 2022.

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Table 1. Key terminology

The increasing interest from business in discussing these ideas is promising.¹⁵ However, a practical connection to business vocabulary seems to be missing.

WHAT MOTIVATES BIODIVERSITY ACTION?

Environmental and behavioral research has proven that although raising awareness is the first step in creating action, it is not sufficient to maintain momentum without routines and practices supporting the change.¹⁶ There are several drivers of business biodiversity action, and while every organization is driven by a unique combination, there are some commonalities.

First, corporate sustainability aims have become a standard organizational practice for many businesses. Biodiversity is increasingly acknowledged as a part of these goals.¹⁷ For example, cosmetics company L'Oréal has measurable biodiversity targets for 2030 that include diminishing impact on deforestation and creating a positive impact on biodiversity at all industrial sites.¹⁸

Second, biodiversity protection is driven by industry-wide practices and guidelines. Institutionalized practices, together with expectations and contributions from customers and other stakeholders, are creating a push for biodiversity action. Industry practices, such as establishing stakeholder networks, can also create a pull for biodiversity responses since stakeholder collaboration provides access to diverse knowledge bases and enhances organizational legitimacy in the face of complex problems.

Third, as human and business impacts on biodiversity loss raise ethical concerns, biodiversity protection has grown into an ethical imperative of public and private decision makers. Ethical reasons also include acknowledging the intrinsic value of nature and biodiversity beyond instrumental benefits, including conserving nature for future generations.

Fourth, policy frameworks seek to guide businesses' biodiversity activities. However, current frameworks and regulations have proven ineffective in addressing biodiversity loss. There is evidence of business responses, but it is not extensive or quick enough. Novel approaches are needed to catalyze immediate, widescale action.

WHY LANGUAGE IS ESSENTIAL TO CATALYZING ACTION

Language shapes how we understand and respond to environmental challenges. Narratives and stories are powerful in making issues and events meaningful and understandable, and metaphors affect our willingness to engage.

Stories and metaphors can be used to maintain the status quo or catalyze change. Performativity of language refers to language functioning as a form of social action. Oral and textual communication transmit knowledge of possible courses of action. Language used as social interaction both enables and limits what is possible and desirable — focus and targets of action, as well as outcomes, are defined in language use.¹⁹

Many of our current terms and metaphors have been proven ineffective in spurring large-scale biodiversity action. Novel approaches are needed to connect actors from various sectors and prompt action, and their vocabulary must resonate across business sectors, cultures, and social groups. A joint vocabulary is needed to make widespread biodiversity protection a reality.

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Practice-based language can activate change. It builds on vocabulary that is already in use and proven effective, accentuating its value across various stakeholder groups. When stakeholders have joint interests and share concepts and language related to those interests, change is more likely to happen.

NATURE-BASED STAKEHOLDER ENGAGEMENT CATALYZING BIODIVERSITY ACTION

When it comes to biodiversity issues, stakeholder engagement is touted as elemental by the private sector, government entities, and nonprofits. That engagement can follow a company-centric or issue-focused model.²⁰ The more traditional company-centric model focuses on achieving the company's goals. Issue-focused models center on a focal issue (e.g., biodiversity protection or nature positive value creation) and create a multi-stakeholder network to address the issue.

Nature-based stakeholder engagement combines the established vocabulary of stakeholder engagement with the term "nature-based," denoting nature as a focal issue for the engagement. The term "nature-based" includes a variety of nature-enhancing activities, such as nature positive, biodiversity protection, and nature-based solutions.

We believe the term "nature-based stakeholder engagement" has both relevance to and resonance with established practices, allowing it to serve as a metaphor for catalyzing and concretizing biodiversity action in a business context.

BENEFITS OF NATURE-BASED STAKEHOLDER ENGAGEMENT

There are four key benefits to the concept of nature-based stakeholder engagement (see Figure 1). First, it directly connects with the idea of joining forces for nature. Partnerships and alliances are widely recognized as key to biodiversity action. Stakeholder collaboration is appealing to many types of organizations since the implications of biodiversity action transcend organizational boundaries.

Second, it enables boundary crossing and knowledge sharing. Most companies lack in-house expertise in biodiversity. When companies partner with nonprofits, they build biodiversity expertise; when nonprofits partner with businesses, they gain business skills. A good example is Shell's partnership with the International Union for Conservation of Nature and UNESCO programs. Through secondments, the organizations increased staff empowerment, job satisfaction, meaningfulness, and expertise.²¹

Third, nature-based stakeholder engagement encourages reliance on local knowledge, an understanding of the challenges and their solutions in their local context, and the need for knowledge exchange among various stakeholders. The idea of mutual learning is at the very core of stakeholder engagement.²² Multi-stakeholder initiatives can support a variety of viewpoints and their integration, bringing together policy makers, businesses, scientists, local communities, and other stakeholders.²³



Figure 1. Benefits of nature-based stakeholder engagement

Fourth, nature-based stakeholder engagement can lead to effective, lasting solutions to support biodiversity action. Effective solutions require expert knowledge that can be gained when businesses collaborate with nongovernmental organizations, public sector actors, research and academic institutions, and local communities. Certain actions, such as creating protected areas, require active multi-stakeholder collaboration. Various stakeholders have their own interests, but these can often coexist in a network. For example, businesses can focus on their strategic and commercial goals while public actors aim to enhance social welfare.

The idea of nature-based stakeholder engagement puts nature's point of view at the forefront to encourage solution finding and complexity management.

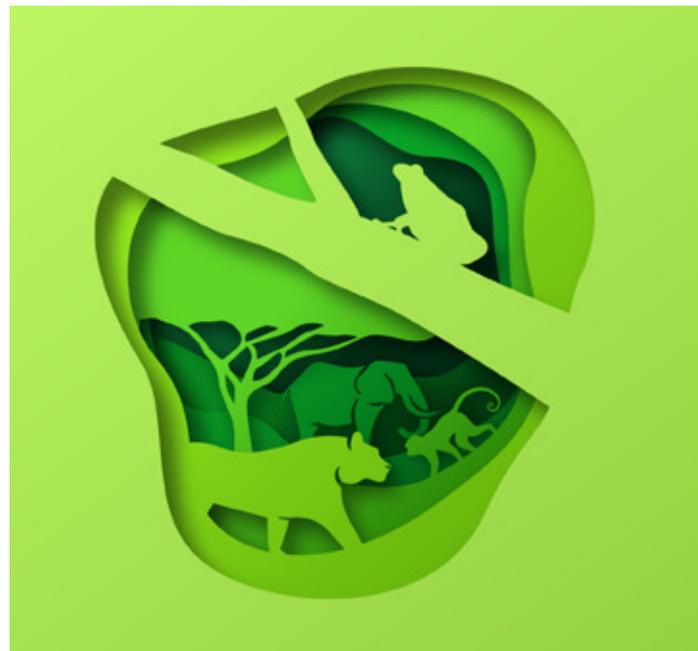
EXAMPLES OF NATURE-BASED STAKEHOLDER ENGAGEMENT

There are already some instances of businesses and organizations enacting biodiversity protection in stakeholder engagement. Energy company Neste collaborates with the wildlife conservation organization Fauna & Flora International in biodiversity conservation. Neste aims to have a positive impact on biodiversity throughout its value chain by 2040.²⁴

Holcim, a multinational building materials company, says it aims to become a leading voice in protecting biodiverse landscapes through multi-stakeholder collaboration. Its target landscapes include forests, grasslands, deserts, and aquatic habitats. These landscapes provide numerous ecosystem services for people while supporting flora and fauna.²⁵

Unilever, one of the world's largest consumer goods companies, highlights the need for stakeholder engagement on biodiversity. It has pressed for an ambitious global agreement and action on nature to build a stable, net-zero, nature positive, equitable future for humanity and life on Earth. In addition to governmental action, Unilever calls for all businesses to take steps now to regenerate nature.²⁶

The Taskforce on Nature-related Financial Disclosures is a good example of an industry-based private sector partnership. As a global, market-led network of 40 large financial institutions and corporations supported by scientific partners and governments, it aims to direct global financial flows toward nature positive outcomes.²⁷



CONCLUSION

We have suggested the term “nature-based stakeholder engagement” as an example of new language that speaks to a wide variety of audiences. Our demonstration serves as an example for business leaders who want to make a difference in action-oriented biodiversity conservation by generating language with the potential to be widely adopted by businesses, institutions, and the conservation community.

The concept of nature-based stakeholder engagement engenders a better understanding of the term “biodiversity” by bringing it to a level where actionable knowledge and effective practices are possible. It thus creates a new category (or expands old categories) of understanding to incorporate the type of change needed in business strategies.²⁸

The term includes both the descriptive aspect (that stakeholder engagement is nature-based because it takes place in and depends on human-nature interaction) and the normative aspect (that stakeholder engagement should be nature-based because non-human actors should be stakeholders and because the biodiversity crisis makes this unavoidable in the end).

The concept of nature-based stakeholder engagement provides business leaders and stakeholders a basis for mental leaps toward creative actions, opening up an entirely new set of topics related to concrete actions affecting biodiversity.

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LEVERAGING INSIGHTS FROM MINI-PUBLICS TO DEVELOP BIODIVERSITY STRATEGIES

Authors

Simon Pek and Nicholas Poggioli

How can business leaders develop and implement strategies that protect the diversity of life on which their firms depend? Leaders have strategic agency on biodiversity: they can increase it by protecting ecosystems owned by their firms, supporting an increase in protected areas, rewilding and restoring degraded ecosystems, restocking depleted species, and managing operations in ways that do not decrease biodiversity in supply chain ecosystems.¹

Conversely, leaders can decrease biodiversity by converting high-biodiversity ecosystems into low-biodiversity monocrop fields, damaging coral reef ecosystems by releasing carbon waste into the atmosphere, or replacing diverse coastal mangrove ecosystems with tourism resorts. In extreme cases, managers can drive ecosystem biodiversity to zero by destroying whole ecosystems.

A small but growing body of research is pointing to practices that help business leaders understand biodiversity issues and incorporate them into effective strategy. Examples include learning how businesses' operations rely on and impact biodiversity, developing trusting relationships with communities, engaging in dialogue with stakeholders, and carefully attending to legal and regulatory frameworks.^{2,3}

INSIGHTS FROM BIODIVERSITY MINI-PUBLICS CAN SERVE AS VALUABLE INPUTS TO STRATEGY DEVELOPMENT & EXECUTION

In this article, we discuss another way business leaders can develop and execute effective biodiversity strategies: learning from deliberative mini-publics focused on biodiversity, such as the recently completed Citizens' Assembly on Biodiversity Loss in Ireland.⁴

Mini-publics are initiated by entities like governments to bring together a group of participants that deliberate and issue recommendations about a public policy issue. Conveners select participants through a democratic lottery to ensure representativeness, equip participants with balanced and comprehensive information on the issue through briefings and stakeholder and expert presentations, and employ trained facilitators to engender productive and inclusive deliberation. The main reason mini-publics have received so much attention in recent years is the quality of their recommendations, which stems from participant diversity and impartiality.

Insights from biodiversity mini-publics can serve as valuable inputs to strategy development and execution. For example, they can help business leaders quickly understand complex supply chain ecosystems and the biodiversity dynamics within them.

Below, we explain why and how biodiversity matters to strategy. We then discuss what managers can learn from deliberative mini-publics on biodiversity and how to incorporate what they learn into biodiversity strategies. Finally, we describe how businesses can support the implementation and dissemination of biodiversity-focused mini-publics and how businesses can engage with mini-publics in ways that protect their integrity.



WHY BIODIVERSITY MATTERS TO STRATEGY

In a world of competing strategic demands, why should business leaders develop strategies focused on biodiversity? First, businesses rely on ecosystems to produce and reproduce the variety of life that enables economic and social systems. Second, biodiversity decline (or collapse) poses reputation risks to businesses, and business leaders must anticipate and mitigate the risk of being targeted by activists. Third, life on Earth has inherent value that managers should help preserve rather than destroy. Biodiversity mini-publics can help managers successfully engage on all three issues.

Biodiversity decline raises operational risks because ecosystems no longer meet business needs.⁵ To ensure stable operations, managers must understand which ecosystems their business relies on, how those ecosystems function, and how biodiversity affects ecosystem function.⁶ For example, agribusiness firms use biodiversity strategy to assess and manage risks from declining pollinator-insect biodiversity.⁷ Similarly, fashion firms like French luxury goods group Kering rely on plant and animal materials produced by ecosystems in their supply chains, and biodiversity decline directly threatens their core business operations.

Activist groups, governments, and other organizations increasingly connect business operations to biodiversity impacts in specific ecosystems and pressure businesses to reduce impacts by changing operations.⁸ It is reasonable to expect continued innovation in linking businesses to ecosystem impacts: more firms will be pressured to account for, reduce, or eliminate their biodiversity impacts.

Finally, the inherent value of life on Earth should be acknowledged and protected rather than destroyed by business activity. This could take the form of executives prohibiting their firms from harming or killing living organisms. Or it could take a weaker form: the business can harm and kill living organisms and ecosystems but cannot contribute to causing complete species extinction or habitat destruction.⁹

BIODIVERSITY MINI-PUBLICS

Biodiversity mini-publics are a subset of a family of democratic innovations called “deliberative mini-publics” that are initiated to provide judgments about a particular topic.^{10,11} Before discussing biodiversity mini-publics, let’s look at mini-publics more broadly.

Initiators provide resources for a mini-public and play an important role in shaping decisions about its scope and focus. Mini-publics often include regulators, governments, nonprofits, and academics; they sometimes include businesses. Much of the actual design and execution of mini-publics is undertaken by conveners, who often have extensive training and experience with public deliberation. Both initiators and conveners often receive support from advisory committees.

What differentiates mini-publics from stakeholder panels or town halls is that they use a lottery system to select participants from a target population, as opposed to election or self-selection. Once selected and onboarded, participants learn about the issue at hand by consulting balanced briefing materials and participating in presentations by stakeholders and experts. With the aid of trained facilitators, they deliberate in a mix of small-group and plenary sessions. Small-group deliberations are usually private; many plenary sessions are made public.

After deliberating, participants issue their recommendations, usually via collective positions or individual survey responses. These are documented in a report that is disseminated to the initiating body and, usually, to the broader public.

Much of the excitement over mini-publics in recent years can be attributed to the unique qualities of the recommendations generated by participants.¹² The lottery selection system brings together diverse groups that are more representative than committees that rely on self-selection or town hall forums that use elections to determine who will attend.¹³ Coupled with efforts to support learning and deliberation, these groups generate a richer, more comprehensive set of insights on the topic at hand.

Furthermore, mini-public participants can act in a relatively impartial and independent manner. They do not represent particular constituencies and are not subject to the dynamics of electoral politics, so they can focus on longer-term, more complex, more controversial issues and are well-placed to critically engage with and weigh expert knowledge when making decisions.^{14,15}

Mini-publics have been initiated to help tackle a wide range of social and environmental issues around the world, including genetically modified food, public transportation, and homelessness. Recently, there has been an increase in climate-focused mini-publics, including Scotland's Climate Assembly and Climate Assembly UK.¹⁶

However, despite the importance of protecting biodiversity and restoring ecosystems to increase biodiversity, mini-publics have seldom been initiated to focus on that topic. There are two important exceptions. World Wide Views on Biodiversity was a pioneering effort to foster deliberation about biodiversity.¹⁷ Roughly 3,000 individuals from 25 countries participated in day-long forums in September 2012. Participants were selected through a mix of selection methods, including lotteries and targeted recruitment. They deliberated about a standardized set of topics and cast their votes on specific questions. The results of the votes were collated for comparative purposes. As an example, 85.71% of participants voted in support of a proposal asking, "Should users of genetic resources from the high seas pay a fee to global biodiversity for being allowed to use them?"¹⁸

**MINI-PUBLICS
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A more recent example is Ireland's Citizens' Assembly on Biodiversity Loss, which was launched in 2022 and held its last meeting in January 2023.¹⁹ It brought together 99 participants (selected through a lottery) and one chair to provide recommendations on how the government can address biodiversity loss. As of this writing, the participants' sector-by-sector recommendations are yet to be published. However, a November 2020 press release announced that the group had voted in favor of some significant recommendations, most notably a constitutional amendment that would put biodiversity safeguards in place.²⁰

LEVERAGING BIODIVERSITY MINI-PUBLICS

Businesses can leverage mini-publics as inputs into biodiversity strategy formulation and implementation. We see four main sources of insights: (1) public stakeholder and expert presentations, (2) submissions to the mini-public from individuals and organizations, (3) recommendations produced by the mini-public, and (4) reactions to mini-public recommendations.

First, businesses can assign individuals to observe public plenary sessions where stakeholders present diverse perspectives on biodiversity function and dynamics. For example, during the second weekend of the Irish Citizens' Assembly on Biodiversity Loss, farmers and researchers with deep experience and expertise on specific soil and water systems presented on the structure and function of agro-ecological ecosystems and connections between agriculture and biodiversity.²¹

Businesses could also attend such presentations to acquire an information advantage over rivals. Such knowledge would be particularly helpful if it focused on the details of biodiversity structure and function for an ecosystem in the business's supply chain, as that kind of information can be expensive, if not impossible, for businesses to gather. In a business-initiated biodiversity mini-public, participants might offer insights into the relative cost-effectiveness of various ways of protecting or increasing biodiversity within a specific ecosystem or how to responsibly leverage ecological knowledge.^{22,23}

Biodiversity strategy formulated with comprehensive, accurate information about ecosystem structure and function, the business's dependence and impacts on the ecosystem, and biodiversity risks arising from dependence and impacts could provide an advantage over businesses with strategies based on broad assumptions.

Second, businesses can review materials that individuals and organizations submit before and during mini-publics to influence deliberations and recommendations. For example, the Citizens' Assembly on Biodiversity Loss received submissions from 507 individuals and 137 organizations.²⁴ One organization, Natural Capital Ireland, supports the adoption of integrated natural capital concepts in public policy and corporate strategy.²⁵ It calls for legally binding policies to halt biodiversity loss, recommends the Irish government adopt natural capital accounting systems, and reviews current and pending legislation relevant to natural capital concepts and practices. Reviewing such materials offers businesses an efficient means of identifying new concepts and the degree to which those concepts might influence regulatory changes. Submissions can also reveal market opportunities into which a business might expand, such as natural capital accounting related to quantifying biodiversity impacts.

Third, businesses can read and engage with the recommendations produced by a mini-public to understand the full spectrum of priorities and values held by an informed and diverse group of stakeholders. This can help fill two common knowledge gaps: what issues stakeholders care about and how much they care about each issue.²⁶ The Citizens' Assembly on Biodiversity Loss will make a report and recommendation to the Irish government about how public policy can, and should, prevent further biodiversity loss.

Businesses can use recommendation reports to gauge which biodiversity issues are likely to gain traction with policy makers, informing biodiversity strategy development with a more complete understanding of regulatory risks. Businesses that pay attention to these recommendations will be better prepared to strategically engage in political influence campaigns around biodiversity policy.

Fourth, reactions to mini-public recommendations by media outlets, public interest organizations, activist groups, policy makers, industry and trade groups, and other businesses can reveal what stakeholders prioritize about biodiversity and provide insights about future consumer behavior related to biodiversity. Recommendations about potential regulations generated in the Citizens' Assembly on Biodiversity Loss will likely generate reactions ranging from informal social media posts from consumers and activists to formal policy-position statements by advocacy organizations, industry and trade groups, and other businesses.

Monitoring these reactions can help businesses understand the biodiversity policy positions that matter most to a business's priority stakeholders. Reactions may also suggest potential collaborators such as trade or industry groups that share a company's preferred biodiversity policy positions.

The nature of these insights will depend on the role businesses take vis-à-vis the biodiversity mini-public. If they play a role of initiator, they will be able to shape the scope and remit of the mini-public, and the insights will be more tailored to the business's specific operating context. If not, they can still leverage more general insights from mini-publics initiated by other parties, like Ireland's Citizens' Assembly on Biodiversity Loss.

RESPONSIBLE ENGAGEMENT

We have emphasized the benefits for businesses in leveraging insights from biodiversity mini-publics. However, the way businesses engage with mini-publics can distort deliberation, reporting, and other processes, undermining their legitimacy and reducing the strategic value of mini-public outputs. Thus, businesses must carefully weigh decisions about when and how to engage with biodiversity mini-publics. Deliberative democracy experts have helpfully highlighted three principles essential to protecting the integrity of mini-publics: transparency, accountability, and independence.²⁷

For transparency, it is important for businesses to be clear and open about any roles they are playing in biodiversity mini-publics, both when observing a plenary session and putting names forward to serve as stakeholder witnesses. If a business chooses to initiate a biodiversity mini-public, it should take care to select conveners that have the experience and resources needed to be clear and forthcoming about the mini-public's remit, funding sources, structures, and processes in media releases, reports, and websites, and it should provide conveners with the necessary resources to do so.



For accountability, initiators and conveners must be responsive to questions and concerns raised by participants, stakeholders, and the public. If a business initiates a biodiversity mini-public, its managers should provide conveners with explicit direction, resources, independence, and security to respond to questions and concerns raised by all parties, without interference from the business.

Businesses must also ensure mini-public independence by safeguarding it from undue influence by parties like initiating bodies and stakeholders. Prior research points to rules of thumb in this regard.^{28,29} First, while businesses can initiate mini-publics or provide funding and resources for them, they should avoid playing the role of convener. Instead, they should hire expert conveners with experience undertaking these processes. Second, if staffers have experience and knowledge relevant to the biodiversity mini-public, businesses can put them forward as potential advisory committee members, stakeholder witnesses, and expert witnesses. Staffers participating in these roles are unlikely to compromise the integrity of the mini-public.

CONCLUSION

It is important to note that biodiversity mini-publics are just one means through which company managers can learn about the business conduct and public policy preferences of stakeholders and the broader public. Mini-publics are one of many practices increasingly used to revitalize democracy, alongside social movements and initiatives to boost participation in the political process. Businesses can draw on insights from these practices to develop more comprehensive biodiversity strategies. As with biodiversity mini-publics, they should take care to engage thoughtfully and responsibly to safeguard efforts at democratic revitalization.

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THE CIRCULAR ECONOMY'S ROLE IN BIODIVERSITY PROTECTION

Authors

Paul Dewick and Joseph Sarkis

Humans need to acquire resources from nature to survive, but our consumption has become unsustainable. This overconsumption not only deprives future generations, it means that resources have become scarce for other species. In fact, human consumption and production patterns have already put pressure on (or caused the extinction of) other life forms.¹

It is time to rethink our human-focused approach to the natural environment and our indiscriminate use of nature's resources.

This article discusses ways to reduce biodiversity loss using principles related to the circular economy (CE). Although CE is no panacea, we believe it has a role to play in reducing resource throughput and protecting biodiversity.

AVOIDING THE BIODIVERSITY BLIND SPOT IN THE CIRCULAR ECONOMY

CE has recently been promoted as an alternative economic model that supports national and regional agendas for recovery, renewal, resilience, inclusiveness, equality, and sustainability in a post-pandemic world. Its principles include designing out waste and pollution, keeping high-value products and materials in use, and regenerating natural systems (see Figure 1).²

Strategies for circularity include:

- **Narrowing** resource loops by reducing resource intensity and optimizing resources. For example, the smartphone replaced cameras, phones, calculators, game consoles, and even computers.
- **Slowing** resource loops through prolonging and intensifying product use. For example, products like computers and electronic appliances could be designed to be more durable for longer use.

- **Closing** resource loops by replacing virgin materials with reuse, recycling, remanufacturing, and resource cascading. For example, computer and copier components could be reused within modular systems.
- **Regenerating/restoring** resources by preserving and enhancing natural capital. Renewable energy systems are a good example.

Adoption of the CE model has been slow, but changing norms, increasing knowledge, and new incentives and financing are starting to drive CE-related implementations across major industries and large, influential companies.³ These organizations are mostly headquartered in the more economically developed regions of the world.

Various communities of practice worry that this transition to a broader circular economy is taking place too quickly, that governments and organizations may be so enthusiastic that they are not paying enough attention to the unintended consequences of CE actions. Indeed, history is littered with policies and strategies that had unintended consequences. Sometimes these responses have led to even more difficult-to-tackle problems; local and regional air pollution is a well-documented example.

We (and other voices) have aired concerns about wider environmental and social sustainability factors being neglected in CE-related thinking.^{4,5,6} A crucial blind spot relates to biodiversity.

Biodiversity refers to the variety and abundance of life on Earth; it includes genetic diversity within species, diversity between species, and diversity of ecosystems. The December 2022 United Nations *Convention on Biological Diversity (COP 15)* drew attention to the need for urgent action, without which “there will be a further acceleration in the global rate of species extinction, which is already at least tens to hundreds of times higher than it has averaged over the past 10 million years.”⁷

The resulting Kunming-Montreal Global Biodiversity Framework includes targets to conserve and restore biodiversity. It commits to protect at least 30% of the Earth’s lands, inland waters, coastal areas, and oceans by 2030. It is a significant call to arms around conservation efforts, one that has been recognized and endorsed by scientific communities such as the Half-Earth project, which is dedicated to the protection of biodiversity.⁸

Progress toward biodiversity targets is inextricably linked to changes in consumption and production. Through their global value chains, the negative biodiversity impact of multinational corporation operations extends far and wide across these systems. The World Bank estimates that 90% of total biodiversity loss can be associated with the management of resources within consumption and production systems.⁹

This begs the question: could strategies based on CE-related thinking support the goals of the Global Biodiversity Framework? The short answer is yes. However, we can neither assume that CE-related actions will not hinder biodiversity goals (or other environmental or social goals) nor expect that integrating biodiversity into company strategies and operations will be simple.¹⁰

PROS & CONS OF CE PRACTICES FOR BIODIVERSITY PROTECTION

There has been a recent flurry of activity exploring the relationship between CE and biodiversity. The Global Alliance on Circular Economy and Resource Efficiency (GACERE) is a UN Environment Programme initiative involving governments, businesses, and nongovernmental organizations. Its 2022 working paper on circular economy and biodiversity lays bare the evidence on biodiversity loss, its drivers, and its impacts on society and the economy.¹¹ It also considers how CE-related actions could help reduce biodiversity loss and restore ecosystems.

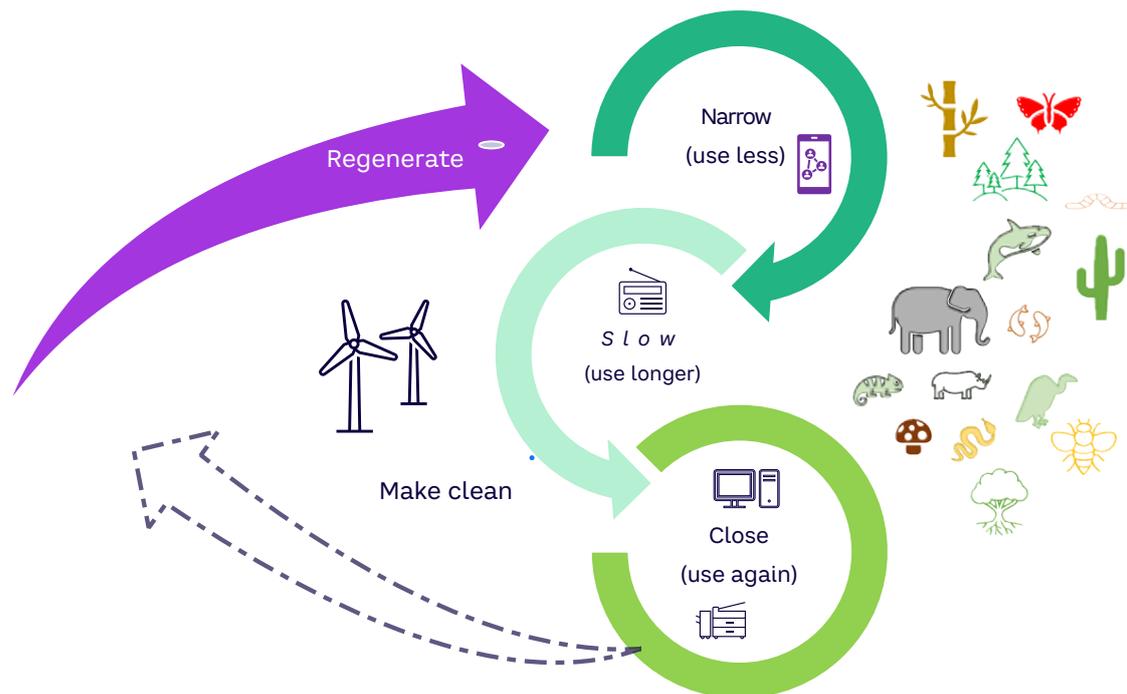


Figure 1. Strategies for circularity

The study emphasizes the hitherto neglected restorative and regenerative practices of circular actions. To date, many circular actions have been directed at keeping products and materials in circulation through reuse, repair, refurbish, remanufacture, and recycle.¹²

GACERE is not alone in calling for circular thinking among government and business to take biodiversity into account. In 2022, Finnish innovation fund SITRA published a study analyzing and quantifying CE's role in halting biodiversity loss.¹³ Both GACERE and SITRA focus on sectors where circular actions have the largest biodiversity impacts: food and agriculture, construction, and forestry. These industrial sectors influence biodiversity through habitat loss and fragmentation, land degradation, materials extraction, and pollution to land and waterways.

Take the construction sector, for example. It is well known for its high environmental impacts, not least as the principal user of cement, the production of which accounts for around 5% of global carbon dioxide (CO₂) emissions.¹⁴ CE actions would certainly help mitigate climate change, both through slowing and closing strategies that keep materials and minerals in circulation and from regenerative strategies that make greater use of renewable energy.

The biodiversity impacts of construction are just as pernicious. Its operations reduce and fragment natural habitats, relying on the extraction of raw materials (aggregates, wood, metals, etc.); its products directly occupy land (buildings, roads, pathways, etc.); and its waste requires land for treatment and disposal. Implementing circular strategies to avoid these land-use impacts is essential for preventing further biodiversity loss and rebuilding natural capital.

Table 1 summarizes some of the actions related to strategies within construction and other leading sectors that can reduce biodiversity loss and restore ecosystems. Interested readers can find more details in the reports and articles of GACERE,¹⁵ SITRA,¹⁶ Enni Ruokamo and her colleagues (who studied the potential of CE in the construction and forestry sectors to mitigate pressures on biodiversity in Finland),¹⁷ and Juan Velasco-Munoz and his colleagues (who studied CE implementation in the agricultural sector).¹⁸

It is worth noting that these strategies sometimes overlap. For example, slowing and closing implicitly involve narrowing; some closing strategies are inherently regenerative (e.g., cascading organic material to be used as fertilizers).

SECTOR	NARROWING	SLOWING	CLOSING	REGENERATING/RESTORING
Food & agriculture	Avoiding overproduction; shifting to plant-based diets	Extending life of agri-food products (e.g., reducing waste in production and preservation)	Cascading animal and food waste to recover nutrients	Shifting from synthetic to organic fertilizers; employing crop rotation; planting greater varieties of crops; extending agroecology approaches that co-create processes, combining science and industry expertise with indigenous knowledge and techniques
Construction	Optimizing material use (e.g., cement, metal) and space use in buildings; reducing waste	Extending life of buildings	Reusing and recycling concrete waste in civil engineering (roads and streets) and wood materials (buildings)	Designing urban space with "room for nature," both within and beyond building footprint; developing higher-density urban living; channeling extracted materials toward terrestrial or freshwater projects
Forestry	Optimizing material production (e.g., paper, pulp); reducing waste	Increasing the durability and longevity of forestry products (e.g., furniture)	Reusing and recycling wood products	Wider adoption of regenerative forestry

Table 1. Sector-specific circular actions to support biodiversity

Not all circular actions benefit biodiversity. For example, material-selection choices that shift from nonrenewable materials to biomass (especially in the construction and forestry sectors, but also bioplastics in the consumer goods sector) and actions that substitute nonrenewable energy sources for bioenergy can affect land use and threaten biodiversity. Similarly, CE regenerative practices involving renewable energy technologies that use significant rare earth elements result in environmental issues stemming from mining and extraction.

Global CE efforts sometimes send materials to developing nations that may not have appropriate infrastructure and cause damage to local ecosystems. The CE model has also been criticized for encouraging economic growth that is not sustainable, triggering a rebound effect where more resources are used because of greater consumption due to less guilt in causing environmental burdens.

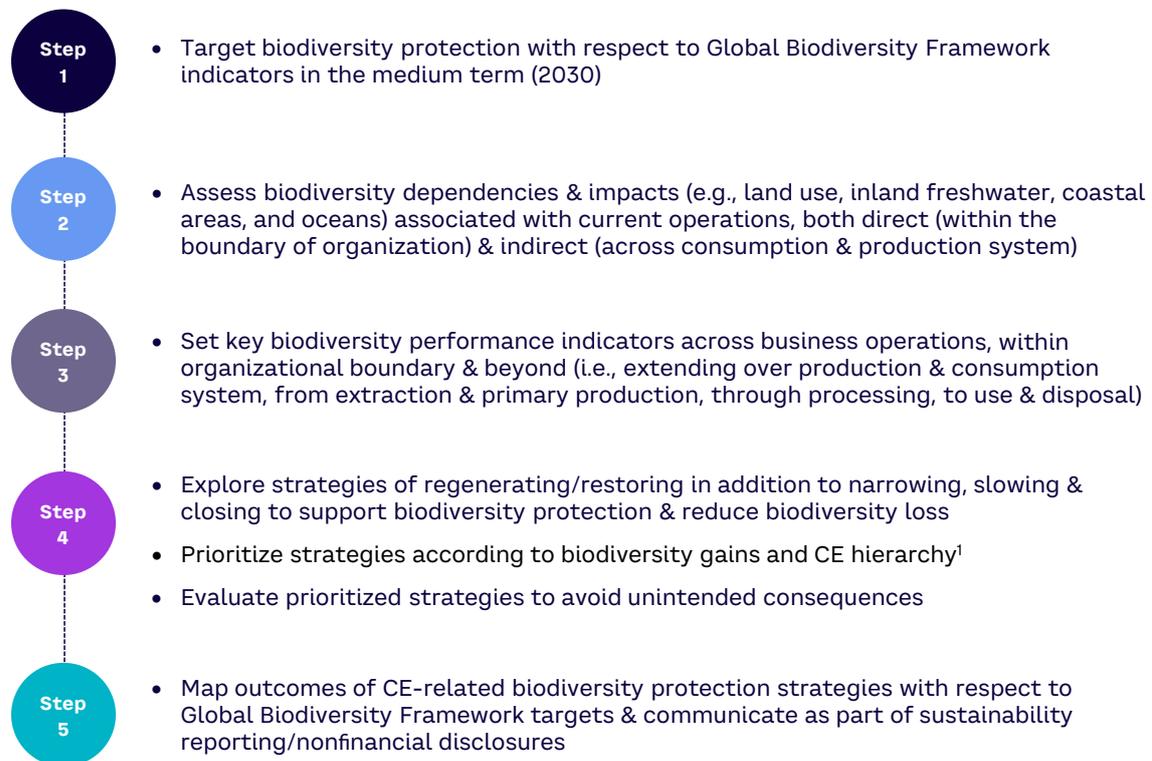
In a previous *Amplify* article, we introduced the concept of “strong” and “weak” sustainability models for CE.¹⁹ A strongly sustainable CE can support biodiversity; a weakly sustainable one can hurt it.

IMPLEMENTING CIRCULAR STRATEGIES FOR BIODIVERSITY PROTECTION

The Kunming-Montreal Global Biodiversity Framework is based on a theory of change involving government, business, and society to “determine priorities, allocate financial and other resources, internalize the value of nature and recognize the cost of inaction.”²⁰

Although food and agriculture, construction, and forestry are in the vanguard, transformation of the sort demanded by the Global Biodiversity Framework requires that all organizations (large and small, private and public) contribute their “fair share.” Figure 2 outlines an underlying process through which an organization from any sector can assess and report on the relationship between circular strategies and actions that protect biodiversity.

Using science-based targets can help organizations demonstrate they are doing their fair share. The process shown in Figure 2 can be picked up by organizations and adapted to their context. When



¹ “Tackling Root Causes: Halting Biodiversity Loss Through the Circular Economy.” SITRA, 15 May 2022.

Figure 2. Circular strategies and biodiversity dependencies and impacts: assessment, selection, evaluation, and reporting

organizational sustainability strategies are developed, the roles of the many dimensions of environmental and social concerns must be carefully evaluated.

Organizations already complete various sustainability reports and materiality indices. Integrating CE and biodiversity initiatives and measures into current corporate and supply chain sustainability practices, systems, and data is necessary to realize the commitments of the Global Biodiversity Framework. In the next section, we identify some facilitating mechanisms to help organizations design circular strategies for biodiversity protection.

FACILITATING MECHANISMS

Robust strategies that protect biodiversity and contribute to wider sustainable development goals are optimal. Although the two challenges are often considered separately, pursuing CE strategies that protect biodiversity and have co-benefits for climate change mitigation and adaptation will get support from the broader policy and environmental advocate community. Performance evaluation and measurement approaches, evidence-based analysis, and supporting tools and technology for decision-making are all necessary to help organizations identify these environmental synergies. For example, regenerative farming and farm-to-farm trading in carbon credits can support carbon capture while encouraging more efficient farming practices and reducing the need for further farmland expansion.²¹

Significant IT support will be needed to manage these data-intensive efforts (requiring the potential capture of billions of pieces of information related to land use and carbon-capture savings) and to integrate stakeholder trading mechanisms and tools. The data must be reliable, traceable, transparent, and easily accessible. Without it, businesses, policy makers, and other stakeholders will never be convinced that achieving multiple goals is possible.

Stakeholder engagement in co-creating processes that combine science and industry expertise with indigenous knowledge and techniques is particularly important for biodiversity

protection — but organizations must go further. In some of the most biodiverse regions of the world, native indigenous communities are the most likely to be affected when CE strategies are rolled out or scaled up.

Measures will be needed to afford these communities beneficial outcomes. At a minimum, stakeholder engagement should extend to training, knowledge development, and incentivization. Businesses, supply chains, and governments will need to effectively cooperate with various communities and representatives to make sure that negative consequences do not occur.

ROBUST STRATEGIES THAT PROTECT BIODIVERSITY & CONTRIBUTE TO WIDER SUSTAINABLE DEVELOPMENT GOALS ARE OPTIMAL

CONCLUSION

Reducing biodiversity loss is not enough; we must create conservation plans that regenerate habitats and restore degraded areas. Adoption of the Global Biodiversity Framework is an ambitious commitment to conservation. Achieving its goals relies on government, business, and society stepping up. Pursuing CE strategies that narrow, slow, close, and regenerate resources can be part of that coordinated response.

Ultimately, humans and their systems are part of the Earth's biodiversity. Damaging ecosystems means damaging human systems. The Earth, in the long run, will not care what we do; humans are the ones that should care.

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WHAT FLOATING OFFSHORE WIND FARMS TELL US ABOUT BIODIVERSITY REALITIES



Author

Rafael Sardá

Fifty years ago, when I was in high school and my science teacher asked me whether the amount of carbon in the atmosphere was a constant, the answer should have been “yes.” Today, that is no longer the case. The amount of carbon in the atmosphere is increasing due to greenhouse gas emissions that absorb the planet’s thermal radiation and are heating its four components (atmosphere, hydrosphere, lithosphere, and biosphere).

It is evident that crossing the 2°C threshold of global warming would expose humankind to serious health and safety challenges. Everyone is aware of the problem: the World Economic Forum’s “Global Risks 2023 Report” clearly states that the climate issue, with its environmental catastrophes and extreme weather events, is the highest risk for humanity in the coming decade, with biodiversity loss and ecosystem collapse following closely behind.¹

This situation means implementation of the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement must begin as soon as possible. The agreement requires systemic change using a wide range of solutions, of which renewable energy is one of the most attractive. Clean, green (land-based) or blue (water-based) energy sources must replace our dependence on fossil fuels to reduce at least one of today’s planetary risks.

This is hardly a simple task. Moreover, if it’s done without proper consideration of ecosystems and potential loss of biodiversity, it could cause more harm than good.

This article looks at the current push to ramp up offshore wind farms, including new regulations and technology improvements. It then considers the negative environmental consequences that could result from moving too fast to build offshore wind farms in highly biodiverse areas like the Mediterranean. Although this article focuses on possible negative environmental results from wind-energy projects in a specific area, similar issues must be considered when planning any large-scale renewable energy project anywhere on the planet.

2 DRIVERS: TECHNOLOGY & GOVERNMENT DIRECTIVES

The European offshore wind farm sector is expanding rapidly, in part due to new technology. There are two main types of marine wind farms: fixed and floating. Fixed structures have been in use for a while and have been widely deployed in areas such as the North Sea.² Their infrastructure and footprint prevent them from being installed in deep or complex seabed locations.

Using new technology, wind turbines can be installed on floating platforms anchored to the seabed with catenaries, chains, steel cables, and flexible anchors. This opens the door to placing wind farms farther offshore in areas with higher wind potential, making them more efficient. The companies promoting these structures say they have a lower environmental impact than fixed structures (this has yet to be proven) and are easier to manufacture and install.

**THE EUROPEAN
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Another reason for European offshore wind farm expansion is the EU's goal of becoming climate neutral by 2050. The EU estimates that 30% of its energy demand will be supplied by offshore wind by 2050, increasing offshore wind capacity from a current amount of 14.6 gigawatts to 300 gigawatts. This would mean multiplying the marine space allocated to wind energy by 15.³ Experts at BloombergNEF predict that one in every nine new offshore wind turbines could be placed on a floating foundation by the mid-2030s.⁴

Directive (EU) 2018/2001, on the promotion of the use of energy from renewable sources, has placed considerable pressure on member states. As a result, the North Sea is becoming an energy powerhouse as nearby countries seek to meet their renewable energy targets. Offshore wind farm development in the Mediterranean is still in its infancy, but that situation is changing quickly.

OVERALL IMPACT

The impact on the fishing industry, ocean organisms, physical and chemical oceanography, and coastal communities from current and planned European offshore wind farms has just begun to be studied but is expected to be significant.^{5,6} Environmental impacts can occur in any of five wind-energy development phases: preconstruction, construction, operation (including maintenance), repowering, and decommissioning.

From available studies, we can conclude that: (1) impacts on ecosystems and biodiversity will not be negligible, (2) the risks posed to marine ecosystems are diverse, and (3) assessment of potential project impacts must be done on a case-by-case basis, at least until a more substantial body of research comes out.

To address possible conflicts between offshore wind farm development and biodiversity protection, the EU in 2014 launched the Maritime Spatial Planning Directive (2014/89/EU).⁷ It placed a legal requirement on member states to develop and implement maritime spatial plans (MSPs) by 2021 at the latest.

However, the EU's 2018 climate-neutral directive caused many member states to accelerate their renewable energy plans, including building offshore wind farms. This caused some disconnects. First, offshore wind farm guidance documents are still weak, especially for floating structures.⁸ Second, MSPs must also now incorporate a key recommendation from the UN Conventions on Climate Change and Biological Diversity, which states that solutions designed to address the climate issue should not make another biodiversity-related issue worse.⁹ This is the purpose of the EU's Do No Significant Harm (DNSH) principle: solutions to one crisis cannot worsen others.

Thus, developing comprehensive MSPs for large-scale offshore wind farms has become quite complex. At a minimum, they require:

- Assessing how existing plans balance energy requirements with other spatial interests, support coexistence, and manage related conflicts
- Taking new planning challenges resulting from large transnational scenarios into consideration
- Identifying requirements for transboundary planning and cooperation at the sea-basin scale in a context of ecosystem management, cumulative effects, energy security, and transnational infrastructure and policy development
- Assessing in the best way possible offshore energy's relation to biodiversity protection, as set out by the International Council for the Exploration of the Sea's Working Group for Marine Planning and Coastal Zone Management¹⁰

CONSIDERING MARINE PROTECTED AREAS

One extremely important consideration for offshore wind farm development is marine protected areas. This includes Natura 2000 sites, a network of core breeding and resting sites for rare and threatened species that stretches across all 27 EU countries (and beyond).

Current EU guidance on wind-energy developments states that when offshore wind projects, whether located inside or outside a Natura 2000 site, are likely to have a significant effect on sites connected to Natura 2000 areas, developers must: (1) pre-assess the relationship(s) between the wind farm and the marine projected area, (2) conduct an appropriate assessment of the site's conservation objectives to know whether the project will affect the site's integrity, and (3) explore whether the project is in the public interest based on findings.

EU guidance clearly states that every project must be evaluated on these three areas. Today, offshore wind farms in the German North Sea serve as an example of successful site selection incorporating marine use change.¹¹

Clearly, the EU has excellent intentions when it comes to protecting its sea spaces. The European Commission states that spaces designated for offshore energy exploitation must be compatible with biodiversity protection, incorporate socio-economic consequences for sectors relying on the good health of marine ecosystems, and integrate other uses of the sea as much as possible.¹²

But time is running out, and industry demands to accelerate offshore wind farm projects may impede the ability of local governments to conduct appropriate assessments regarding impacts on marine protected areas.



CONSIDERING THE MEDITERRANEAN SEA

Apart from pilot projects in France, there are currently no offshore wind farms in operation in the Mediterranean. However, that situation is likely to change, as MSPs have already been published, raising concerns about possible effects on marine wildlife and ecosystems already being affected by activities like commercial fishing, cargo ships, recreational watercraft, and aquaculture.

Of great concern is the fact that the narrow continental shelf and steep bathymetry in many parts of the Mediterranean mean that most offshore wind projects will need to be developed close to the coast, where there is strong wind power. Unfortunately, this area has a large number of marine-protected areas, making it extremely difficult to balance wind-energy needs with biodiversity goals.

For example, Spain has almost 3,100 miles of coastline. The offshore wind industry is understandably interested in making the Iberian Peninsula its European hub, and the Spanish government is eager to use wind energy to help it transition away from fossil fuels.

Recently, an area off the Spanish coast was opened to the offshore wind industry for development. Six companies have proposed projects to develop 1 gigawatt of wind-sourced electricity in this area, designated as LEBA-1.

Some of the companies are established corporations with stated sustainable policies; some are new companies with no mention of sustainability on their websites. This is important because LEBA-1 is completely surrounded by marine protected areas. Some of these areas are the most biodiverse in the Mediterranean Sea region.¹³ Without careful consideration of potential ecosystem disruption and biodiversity concerns, an influx of offshore wind farms in this location could be environmentally disastrous.

Avoiding that disaster requires an emphasis on awarding project permissions to companies with: (1) a strong understanding of how the ocean affects companies and companies affect the ocean¹⁴ and (2) a commitment to corporate sustainability that includes meeting business goals without compromising the ability of natural systems to provide the resources and ecosystem services on which our well-being depends.

CONCLUSION

Europe's transition away from fossil fuels must certainly include alternative energy systems like offshore wind power. At the same time, the EU is committed to keeping critical ecosystems functioning and protecting biodiverse areas.

This means all new offshore wind farms, including floating farms, should be subject to:

- MSP regulations, including careful strategic environmental assessments of all plans
- An appropriate assessment of a site's conservation objectives if an offshore wind farm outside a Natura 2000 site is likely to have a significant effect on protected sites
- An environmental impact assessment showing compatibility with marine strategies (to be carried out before an operational license is granted)

In the Mediterranean and other coastal areas around the world, renewable energy developments should never be considered within marine protected areas, ecologically valuable areas for sensitive species, or connectivity corridors.

Instead, companies seeking to build fixed or floating wind farms must adopt nature positive strategies that recognize the systemic transformation required for the future.

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VERTICAL FARMING INNOVATION: IMPROVING FOOD SECURITY & CONSERVING BIODIVERSITY

Authors

Stefania Pizzirani, Robert Newell, Alesandros
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Agricultural land comprises about a third of total land area worldwide, covering approximately 4.7 billion hectares.¹ To meet the demands of a growing global population, agricultural production on this land has intensified over the last few decades, involving fertilizers, chemical pesticides, irrigation, cropland expansion, genetically modified high-yield crops, precision-farming technologies, and more.²

In particular, pesticide use has become more prevalent on croplands, increasing by nearly 50% since the 1990s.³ Despite substantial yield increases through use of agricultural technologies, the impacts of intensification on biodiversity and ecosystem degradation are well documented.⁴ Excessive use of pesticides has been connected with the contamination of soil and water (both surface and groundwater)⁵ and the loss of beneficial pest predators such as birds and pollinators.^{6,7} Sustainable agricultural food production options are essential to mitigate the burgeoning threat of social and environmental instability.

Businesses are beginning to recognize the threats against biodiversity, especially as governments and corporations come under mounting pressure to align with international policies like the United Nations (UN) Global Biodiversity Framework and Sustainable Development Goals (SDGs). Fortunately, there are many ways companies can contribute to biodiversity protection and conservation. For example, biodiversity expert Rajat Panwar and his coauthors offer a corporate biodiversity strategy typology that includes conservation (occurs onsite before biodiversity loss), restoration (occurs onsite after biodiversity loss), compensation (occurs offsite before biodiversity loss), and reparation (occurs offsite after biodiversity loss).⁸

Given that agriculture affects 11 of the 17 SDGs, there has been a growing call for agricultural business innovations that both provide economic viability and conserve ecosystems (or even restore them).⁹

Humanity has entered what is often referred to as the fourth agricultural revolution, characterized by the ways technologies from fields like robotics, data science, and genomics have enabled innovative techniques and approaches for increasing food production.¹⁰

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PRESSURE**

Among these are technologies enabling indoor crop cultivation. For example, vertical agriculture involves farming in controlled environments without soil, using hydroponic or aeroponic systems and stacked shelves that support crop growth with lighting and nutrient solution systems (see Figure 1). A high-yield, indoor food production method, vertical agriculture has a low environmental footprint and the potential to greatly contribute to biodiversity conservation and restoration.

Vertical agriculture can contribute to all four of Panwar et al.'s corporate biodiversity strategies, but it predominantly exists within a conservation approach. Agricultural researchers use a land-sharing and land-sparing framework to understand this paradigm. Land sharing refers to ecologically friendly agriculture; land sparing refers to increasing yields to reduce agricultural expansion into wildlife habitats.¹¹



Figure 1. Indoor vertical agriculture system (source: QuantoTech)

Vertical agriculture is considered land sparing because it enables large quantities of food to be produced in a variety of small spaces (urban, industrial, commercial, etc.). Vertical agriculture uses no pesticides and much less water and fertilizer inputs than traditional agriculture.¹²

Land-sparing solutions have the potential to contribute to biodiversity objectives, but there is no guarantee the spared land will result in habitat conservation or ecosystem regeneration. Businesses that wish to invest in food production innovations that support biodiversity conservation must be mindful of several considerations around how vertical farming can meet its potential.¹³

Food systems are highly interlinked, from production to distribution to consumption, and there are significant social, cultural, economic, environmental, and political factors that interact with those processes.¹⁴ Understanding how vertical agriculture fits within these larger food systems is critical to advancing more sustainable food production. This article presents three guiding principles for how vertical agriculture businesses can contribute to biodiversity conservation.

3 GUIDING PRINCIPLES

1. DIVERSIFICATION

The diversification principle is the *what* aspect of vertical agriculture. That is, what does the vertical farm produce? The principle is derived from a framework proposed by researchers Sarah Rotz and Evan D.G. Fraser. Their framework for social-ecological resilience in food systems suggests that food system resilience is achieved through diversity of components, connectivity between components, and decision-making autonomy within the food system.¹⁵

Diversity is integral to resilient ecosystems and economic systems because it allows systems to continue to function in the event that a shock significantly impacts a species population or industry.¹⁶ In vertical agriculture, product diversification can contribute to economic resilience and enable access to more markets while increasing its ability to offset the impact of conventional agriculture.

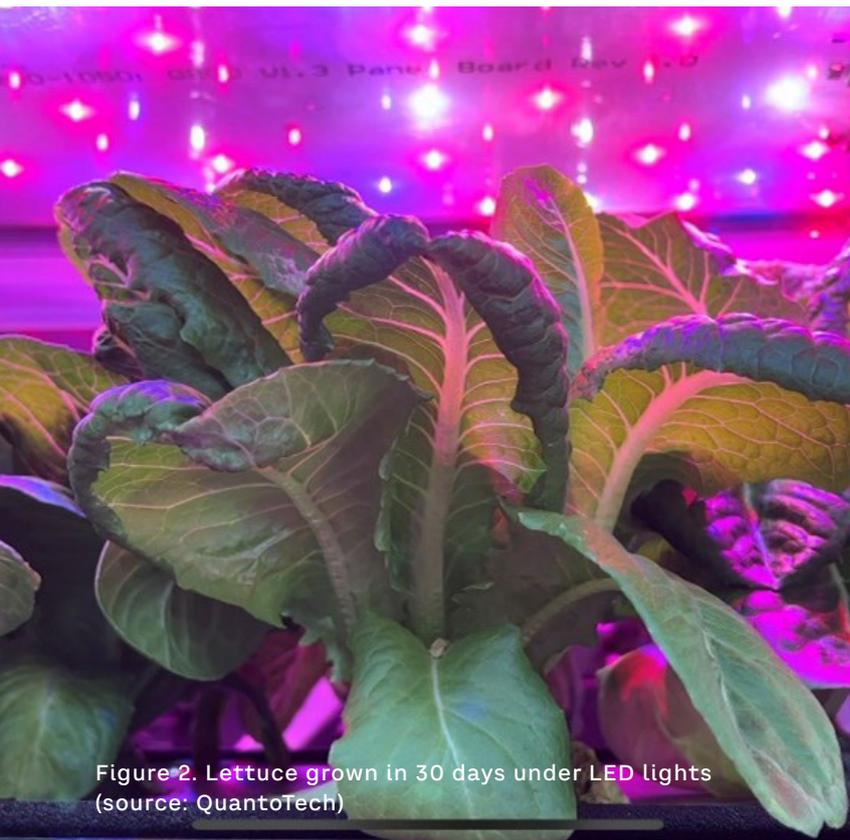


Figure 2. Lettuce grown in 30 days under LED lights (source: QuantoTech)

Currently, vertically farmed products are primarily limited to leafy greens (see Figure 2),¹⁷ and without diversification, its land-sparing potential will be limited by a lack of ability to engage in this form of production for most crops. Businesses must invest in R&D to increase the types of products offered through vertical agriculture so it can play a significant role in food systems, rather than just being used for novelty products.¹⁸ Particularly important is understanding the local markets in which vertical farms exist so they can offer products that align with cultural food preferences and needs.

One example is Freight Farms, a Boston, Massachusetts, USA-based company that distributes grow systems for businesses, not-for-profits, and educational institutions. Although Freight Farms specializes in leafy greens, it is among the few vertical agriculture companies with a diversified crop list: more than 20 crops are highlighted as suitable or under experiment for their technology.¹⁹

The company has successfully grown multiple varieties of lettuce, greens (kale, chard, bok choy), and herbs and is experimenting with flowers and root vegetables. Freight Farms has diversified the fresh produce offerings at community food centers like Lotus House in Miami, Florida, USA, where the farm grows 15 crops for food-insecure individuals. Diversification is a priority and a challenge for container-farming companies like Freight Farms.

2. LOCALIZATION

The localization principle is the *where* aspect of vertical agriculture. That is, where are the vertical farms located? The principle is also derived from Rotz and Fraser's framework, particularly its connectivity dimension, which captures resilience issues related to the long, vulnerable global supply chains of our conventional food system.

The localization principle centers on the need for decentralized food systems, which shorten supply chains, reduce reliance on imports, and partially address emissions and wildlife impacts from vehicle transport.²⁰ Localization and supply chain considerations also relate to vertical farming inputs like seeds and nutrient solutions. If inputs continue to be sourced through ecologically damaging practices, agricultural impacts are displaced rather than mitigated.²¹

Localization would ideally support increased fresh food availability in regions that do not have year-round access to locally grown produce, such as urban areas or remote communities. Container-farming companies have risen in prominence in recent years, with the promise to hyper-localize indoor, vertical production of fresh produce in these areas.

For example, Vancouver, Canada-based QuantoTech specializes in modular grow system technologies and vertical agricultural production.²² It has partnerships with numerous remote communities, such as Mackenzie in British Columbia, Canada, with a goal of increasing year-round access to locally produced vegetables. Modular container-farming systems like QuantoTech's are simple to ship (crucial for remote regions) and scalable in design to support growth and expansion over time.

3. INTEGRATION

The integration principle involves the *how* aspect of vertical agriculture implementation. That is, how is vertical agriculture positioned within the broader food system? Integration is a key component of sustainable, resilient food systems, and an integrated approach allows strategic implementations that align with other sustainability imperatives.²³

For example, vertical agriculture's suitability as an environmental sustainability strategy is compromised by its energy requirement, but integrated approaches can connect vertical farms to distributed energy systems powered by renewable sources.

Integration also refers to connecting to other systems, such as hydroponic-aquaponic systems that provide diversification by adding another product (e.g., fish, seafood). Moreover, integration involves innovations that take a circular economic (CE) approach, in which waste outputs are used as agricultural inputs.²⁴ These practices significantly increase the ability of vertical farming to offset the environmental impacts of the food and agriculture system.

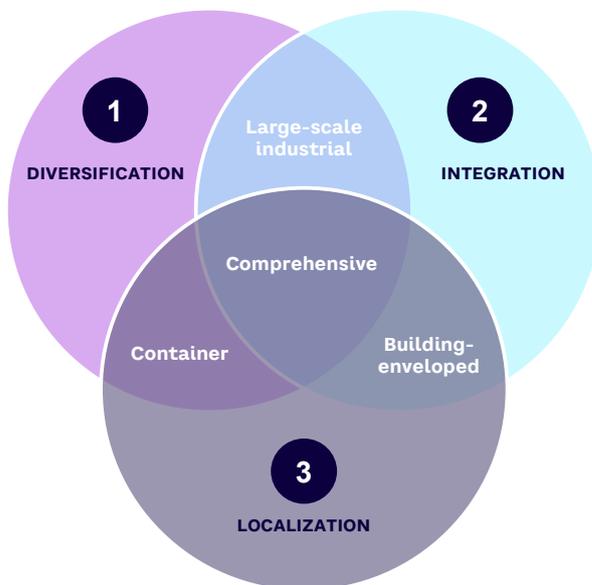


Figure 3. Vertical agriculture business models and their implementation of conservation-related principles

Plant Chicago is a vertical farming company that is firmly integrated within the social, economic, and physical fabric of its city. Formerly a meat-packing plant in Chicago's industrial area, the facility hosts several small-scale business and educational operations that use one another's byproducts.²⁵

Plant Chicago began vertical farming and mushroom-growing practices in 2011 and slowly transitioned into an educational space and social enterprise incubator that offers courses on aquaponics, CE, hydroponics, and mycology, as well as small CE business-networking opportunities. Leveraging byproducts from other small businesses, the site is powered in part by an anaerobic digester to offset the costs of powering the farm.²⁶ By implementing CE development priorities into its mission and daily operations, the facility offers diverse products, contributes to multiple sustainability imperatives, and produces food for local distribution.

APPLYING THE 3 PRINCIPLES: HYPOTHETICAL FARMS & BUSINESS MODELS

The emerging vertical agriculture industry offers clear opportunities to pursue each of the three principles necessary for achieving biodiversity goals. Several companies are actively diversifying the number and type of crops grown in their production facilities, developing contained grow units for hyper-local production, and planning closed-loop production systems, among other business models.

Regardless of model, these companies are actively contributing to land sparing or conservation and possible biodiversity-related benefits. So far, each of the principles we have discussed has been in isolation. In practice, the business models pursued by companies are likely to intersect to contribute to multiple principles at once (see Figure 3). Below, we describe hypothetical business models that integrate each of the guiding principles for vertical agriculture businesses.

Vertical agriculture operations could be developed in large-scale public or apartment/condominium complexes for hyper-local production of leafy greens (what we term the “building-enveloped model”), catering to those accessing the facility such as students, patients, or residents. This model would contribute to integration and localization, but without increasing product offerings at scale, it may fail to contribute to diversification.

Companies could create contained, standalone grow systems (what we term the “container model”) that can produce diverse food items, including fish. Such a model would contribute to diversification and localization but may fail to contribute to integration.

Companies could develop large-scale industrial grow systems for one or a few crops (what we term “large-scale industrial”) and sell their products in conventional supply chains. Such business models would contribute to diversification and possibly integration but may fail to achieve benefits related to localization.

A comprehensive business model incorporates all three guiding principles. Such a model would produce high volumes of diverse produce for local food systems in addition to collaborating with neighboring industry and businesses to implement CE principles at scale. A summary of this and the other three business models is shown in Table 1.

IMPLEMENTATION CONSIDERATIONS

PRACTICAL & MANAGERIAL IMPLICATIONS

A myriad of research and pilot projects demonstrate how vertical farming can play a critical role in promoting sustainability and improving business profitability.²⁷ As discussed, vertical agriculture is gaining popularity as an innovative approach that produces a consistent supply of locally produced, high-quality, fresh fruits and vegetables with low environmental impact.

Careful control of heating, ventilation, air-conditioning, light and water usage, nutrient availability, and other variables allows for a more consistent supply of uniform, high-quality produce at higher yields and with more efficient resource usage. Furthermore, local food production would reduce transport distance and enhance product shelf life, resulting in lower food waste. In cities where land or space is expensive, high-rises and vacant, older properties, including derelict industrial or commercial buildings, could be repurposed into vertical farms, increasing the supply of fresh, healthy food and creating more local jobs.

However, vertical farming carries a range of risks and barriers associated with high start-up costs from high real estate prices, lack of investment capital, limited variety and quantity of products,

BUSINESS MODEL	PRINCIPLES	DESCRIPTION
Container	<ul style="list-style-type: none"> • Diversification • Localization 	Involves designing closed-loop production systems to use waste energy & nearby byproducts to grow multiple items (e.g., crops, fish, insects as feed)
Large-scale industrial	<ul style="list-style-type: none"> • Diversification • Integration 	Focuses on producing multiple crops and/or integrating aquaponics for food sales at local markets & neighboring retailers
Building-enveloped	<ul style="list-style-type: none"> • Integration • Localization 	Involves developing a large-scale building-integrated system for hyper-local production of leafy greens
Comprehensive	<ul style="list-style-type: none"> • Diversification • Localization • Integration 	Centers on developing a highly diversified, closed-loop production system for local food sales

Table 1. Descriptions of vertical agriculture business models and their associated conservation-related principles

and a relatively long time to break even. These factors influence how businesses can scale up to ensure economic viability and a sustained ROI.

Many vertical farms form cross-sector partnerships with venture capitalists, retailers, manufacturers, government, research institutes, and universities to overcome upscaling and funding issues. Examples include Plenty, a California, USA-based indoor vertical farm that partnered with Walmart and three financial investors to help it achieve economies of scale.²⁸

Favorable government policies and institutional endorsement of the technology as integral to food security would boost vertical farming's visibility and help it achieve wider acceptance. Interdisciplinary research involving practitioners from robotics, engineering, biotechnology, construction, government, and academic institutions could document the specific benefits and shortcomings of various vertical agriculture business models. Such collaborations could also explore complementary technologies that would improve both the business viability and the environmental sustainability of vertical agriculture.

COMPLEMENTARY TECHNOLOGIES

As an emerging food production method, a number of complementary technologies and innovations could enhance vertical farming's ability to meet the three principles presented and improve its environmental benefits.

For example, blockchain's traceability features could be used to pursue the localization principle, helping identify and track products within value and supply chains. Blockchain can improve transparency in food systems by providing businesses with opportunities to demonstrate to customers how local their products are and from where they source their farming inputs.²⁹

Such opportunities can be economically beneficial; in a recent survey study on perceptions of vertical farming in British Columbia, most respondents had a favorable view of this form of agriculture and said they would be willing to pay more for vertically farmed products.³⁰

Other technologies that could enhance vertical agriculture include artificial intelligence, robotics, big data analytics, and genomics, which could help

increase crop yield and production efficiencies.³¹ For instance, techniques in functional genomics can be used to identify the best matches for lighting and crop varieties. There are two reasons such efficiencies enhance the biodiversity conservation value and environmental sustainability of vertical agriculture. First, improving yields in smaller spaces (theoretically) improves its land-sparing potential, what is referred to as "sustainable intensification."³² Second, increasing the efficiency of the system serves to (in part) address the energy consumption issues associated with vertical agriculture.

As an indoor, technology-driven farming approach, vertical agriculture can result in higher greenhouse gas emissions compared to conventional agriculture, depending on the efficiency of the systems and energy sources. Since climate change is inextricably connected with the biodiversity crisis, it is important that vertical agriculture explores and implements complementary technologies to reduce its carbon footprint.

POLICY & COLLABORATION

As a new technology, vertical agriculture requires some policy amendments to thrive. For instance, at the macro scale, subsidies such as those offered in Singapore can help overcome conventional technology lock-in.³³ Similarly, land-use designations can be hostile to vertical agriculture because it falls between agricultural and industrial uses. Explicit zoning for vertical agriculture may be necessary, such as the recent amendments to British Columbia's Agricultural Land Use Regulations and the creation of Quebec's Zone AgTech.³⁴

Capital expenditure to establish a vertical farm is high, leading to a longer ROI compared to other industry categories and making these farms highly reliant on venture capital. Such economic challenges can be overcome by government subsidies to kickstart the industry; Japan is an excellent example of this sort of thinking.³⁵

Successful integration into the processing and retail chain is a point of weakness for vertical agriculture, but as the industry matures, these challenges are likely to moderate. On a smaller scale, partnerships like the one that led to a co-location of Gotham Greens and a Whole Foods (located in Brooklyn, New York, USA) will continue to be popular and remain an excellent branding exercise.³⁶

CONCLUSION

Vertical agriculture holds much potential for land sparing and biodiversity conservation, though we note that these tools should be considered a piece of the puzzle in the larger transition to more sustainable, resilient food systems.

On its own, vertical agriculture does not guarantee biodiversity restoration, but it may indirectly contribute to restoration efforts alongside other tools in a land-use management approach. Ultimately, the transition will involve a mix of land-sparing and land-sharing agricultural innovations and solutions.

In this article, we outlined three guiding principles vertical agriculture companies can pursue to achieve the most potential biodiversity-related benefits: (1) diversifying what is being grown; (2) localizing production and sales; and (3) integrating operations with other social, environmental, and economic systems and objectives. A variety of business models in the vertical agriculture industry contribute to these guiding principles to varying and overlapping extents.

We suggest that some combination of all three guiding principles into business models will contribute the most toward potential biodiversity-related benefits through land sparing and conservation. Further research and engagement are necessary to further determine vertical agriculture's potential contributions to biodiversity beyond land sparing, including restoration, compensation, and reparation.

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