Transformation Labs

IDEAS FOR FAST-TRACKING RESEARCH INTO SOCIETAL TRANSFORMATION

futureearth

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UNIVERSITY OF COPENHAGEN

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Transformation Labs
Ideas for fast-tracking research into societal transformation

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Foreword

The Earth is a complex, adaptive system, and humans are an integral part of that system. Our activities are now so intensive that they are affecting the environmental state of the Earth system. This is clearly seen in the biodiversity and climate crises. Much focus is directed toward finding "solutions" to help society deal with these and other societal crises. Complex systems, however, seldom change with quantum leaps or with the help of "solutions". Instead, multiple small changes combine and create the trajectory of the system. In the case of the Earth system, we all seek a trajectory that will allow modern civilizations to continue to thrive, i.e. a trajectory that allows for sustainable development. At the University of Copenhagen, we are convinced that research has already delivered the basis for many small-scale changes that, if implemented, will nurture a more sustainable trajectory for societies' development. That conviction led us to host the Transformation Labs. This catalog is one of the products of these labs. It is a collection of ideas for small-scale changes in the way we go about our lives and do business – changes that can potentially help bring our societies onto a more sustainable trajectory. The catalog is the textual culmination of a long, challenging, but also incredibly inspiring interdisciplinary process. Since February 2023, we – the Transformation Labs team – have worked to compile this selection of interdisciplinary research ideas that address our planetary crises, and which are considered ripe for implementation across the world. The ideas derive from a series of interdisciplinary discussions where scientists and practitioners from across all inhabited continents and various branches of the academic community gathered online to present their perspectives on how we create a better and sustainable future for all. Executing a process of this scale and facilitating discussions across a variety of disciplines is no easy task, and we encountered many challenges along the way. However, the fruits of our efforts – and particularly that of our participants and facilitators – are now ready to be reaped and to inspire practitioners, leaders, and policymakers.

Beyond this idea catalog, the Transformation Labs process resulted in other, albeit less tangible outputs. By gathering scientists and practitioners from around the world, and engaging these people in dialogue, new alliances have been forged, boundaries have been demolished, and new paths for interdisciplinary collaboration have been paved. With all this in mind, we are proud to let this idea catalog reach a broad audience. We hope that many out there will draw from our experiences in the Transformation Labs process, and from our findings, as we together take the most effective steps toward a new sustainable tomorrow.

Katherine Richardson

Katherine Richardson
Professor and leader
Sustainability Science Centre, UCPH

Behind the Project

Transformation Labs was hosted by the University of Copenhagen (UCPH) and led by Professor Katherine Richardson. It was supported by the Future Earth network and a grant from the Novo Nordisk Foundation. To ensure alignment with global sustainability initiatives, members of the 2023 Independent Group of Scientists preparing the 2023 UN Global Sustainable Development Report contributed to the opening sessions of the Transformation Labs.

Transformation Labs (TL) was an explorative online process that served as a laboratory for testing ideas, problems, and proposals that can fast-track research for sustainable development. The goal was to identify research that can advance sustainable socio-ecological transformations within planetary boundaries.

Sustainability Science Centre (SSC) is part of UCPH, and initiated Transformation Labs. The centre is led by Professor Katherine Richardson. Together with Green Solutions Centre, SSC works as UCPH's infrastructure supporting research and educational activities across the university relevant for sustainable development. Both centres have focus on collaboration on research-based green solutions across the faculties of UCPH.

Novo Nordisk Foundation awards grants based on applications, supporting a wide range of areas within health, sustainability, and life science. The Foundation aims to broaden knowledge and research that support green and sustainable transitions of society.

Future Earth is a network of scientists, researchers, and innovators designed to provide the knowledge needed to support transformations toward sustainability. The network focuses on our understanding of complex Earth systems and human dynamics across different disciplines, using this understanding to underpin evidence-based policies and strategies for sustainable development.

Introduction

This idea catalog is the outcome of Transformation Labs - an interdisciplinary process initiated to fast-track research into sustainable development. The catalog aims at policymakers and people who work practice-oriented. The Transformation Labs process was brought forward with the intention to rethink the conventional format of scientific congresses and to identify research-based ideas for sustainable transformation, by highlighting tangible and science-based starting points for implementation. The most promising ideas were compiled into this catalog, which was then circulated among a range of experts, scientists, practitioners, and policymakers engaged with sustainable transformation in various fields. The motivation to initiate Transformation Labs was influenced by the UN Independent Group of Scientists' Global Sustainable Development Report 2019 (GSDR) wherein the need for a stronger science-policy-practice interface is emphasized (see figure 1). The 2019 GSDR highlighted how efforts toward sustainable development often occur in siloes and pointed to a gap between scientific findings and practical transformative initiatives. With the Transformation Labs process, we attempted to proactively accommodate this gap by connecting researchers from across the global academic community with practitioners from various fields, inviting them to discuss innovative research-based ideas for sustainable transformation. The concept of Transformation Labs has previously been used as a method of responding to problems arising in socio-ecological systems (SES) and was developed to address concrete problems with an aim to provide solutions for sustainable transformation (Ely 2021).

We want to stress that complex adaptive systems, such as our planet, are transformed by multiple small steps that stimulate transformation. Action is incremental, but we in science often leave the good ideas in the scientific literature without providing a "how to" for practitioners. Researchers tend to think of the question to be answered and less about how the conducted research can contribute to transformation. Transformation Labs is an attempt to create a change in mindset in terms of how research is conducted, and to encourage all to identify the small steps that can be taken now to stimulate the changes we want and need to curb our planet's state of crisis. Earlier, discussions on sustainable development have focused on the desired vision of a fully evolved sustainable Earth system. However, to reach this goal we took a step back and asked our participants to help us identify existing research products that might stimulate the evolution of that system. In addition to the compilation of a set of research-based ideas for transformation, all of which address a cross-section of the UN Sustainable Development Goals (the SDGs), this process led to novel discussions and interactions between researchers and practitioners from across the world. This created a series of valuable reflections on interdisciplinary processes, which we have included in the postscript at the end of the catalog. It is our hope that these reflections will inform future initiatives toward interdisciplinary dialogue and collaboration, and that our experiences, both the good, the bad, and the ugly, will inform future initiatives.

Katherine Richardson, Rasmus Arildsen and Imme Scholz (on screen) at Transformation Labs' Kickoff event 22nd February 2023

About the process

Transformation Labs took place online between February and September 2023 and was hosted by the University of Copenhagen. It consisted of two kickoff seminars held in February 2023, followed by three guided discussion sessions in March, April, and May 2023. The discussions took place in online working groups, and focused on barriers and pathways for implementing research for sustainable transformation. The working groups were created on the basis of the six entry points for transformation identified by the GSDR of 2019 (see figure 2). During these sessions, research results and products were discussed by a range of scientists, scholars, and practitioners. The knowledge exchange and co-creative exploration of potential ideas happened both during and between three online discussion sessions by means of interactive Miro boards, questionnaires, email exchanges, and on-going comment threads, which together have resulted in this peer-reviewed catalog. The idea texts were written primarily by the facilitators of each group, with the assistance of the remaining Transformation Labs team, and with the input of the participants.

The format of Transformation Labs was designed to promote a global co-creative process, where participants could communicate and discuss across disciplines and national borders. By making it freely accessible to a global audience – and allowing the online discussions to take place over several months – we intended to prevent online fatigue and make sure that the participants were able to contribute despite differences in internet access and quality. The process was free of charge, and the participation of people from a wide range of disciplines and backgrounds is an example of the collaborative potentials fostered by this process. Each of the six working groups of the Transformation Labs worked independently and was led by a team of early-career facilitators. This was to ensure an inclusive process which provided an opportunity for early-career researchers to interact in global discussions, which are often reserved for scholars in higher positions and levels of academia.

As our discussions progressed, it became clear that concrete implementation strategies required focused attention to the abstract and long-term challenges associated with each idea, including temporality, and socio-ecological context. Therefore, each entry point is prefaced with a short introduction that includes reflections on the abstract ideas and challenges raised during our discussions that could not be included as fully-fledged ideas in the idea catalog.

In the final stage of the Transformation Labs process, when ideas were finalized, a series of academics, industry professionals, practitioners, and policymakers were asked to reflect on ideas in the catalog. The resulting video commentary series and this idea catalog are freely available on our website. We hope that these will be shared among researchers and teaching staff as examples of existing research that is ready for implementation. In addition, these outputs exemplify how transdisciplinary work can function and be carried out, including how to improve processes that aim to bridge gaps between disciplines and sectors.

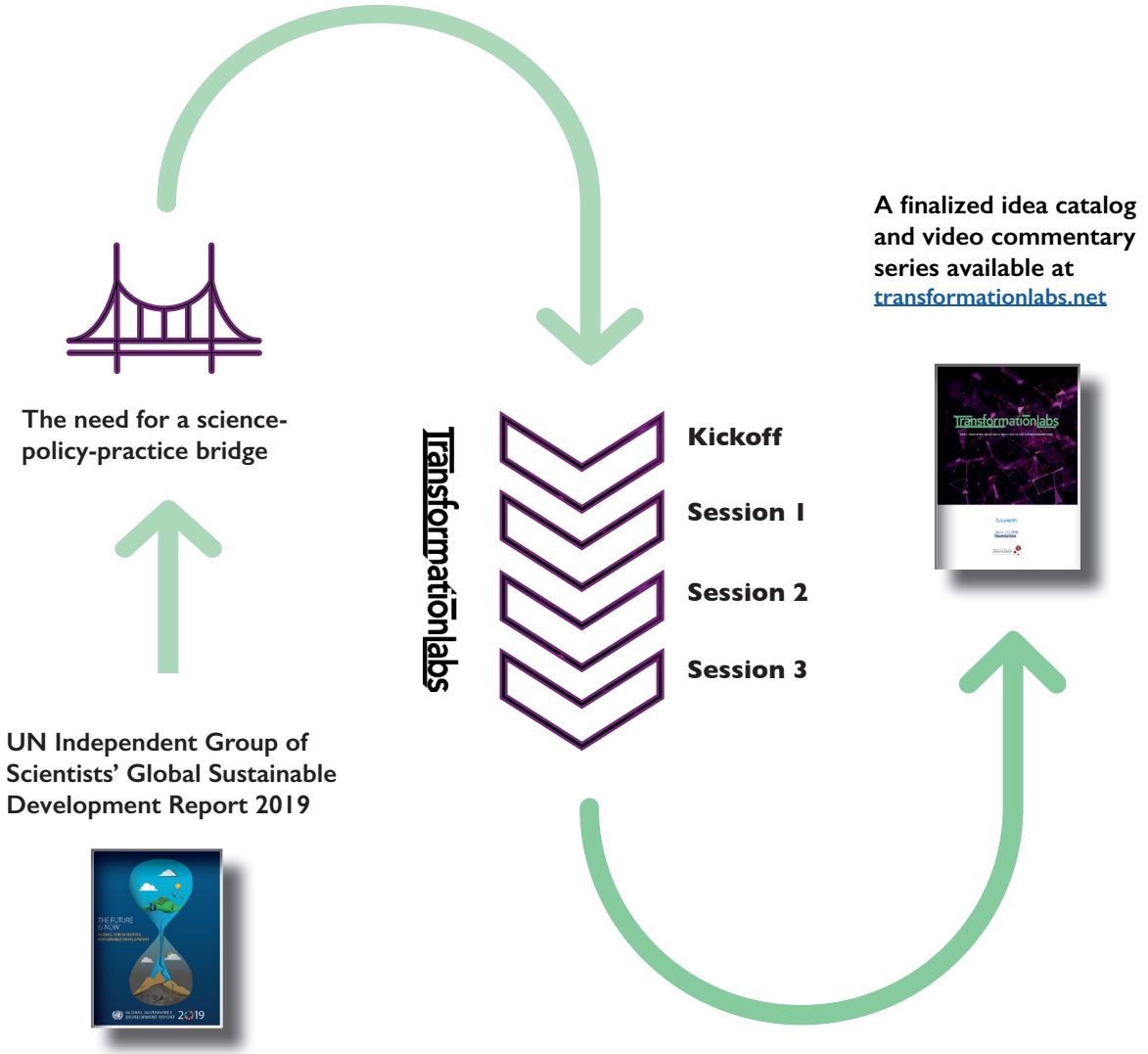

Figure 1 - Development of Transformation Labs

Conceptual clarifications

Entry points

The discussions of the Transformation Labs were divided between six entry points that derive from the 2019 GSDR report. An entry point is a thematic area which is deemed to "offer the most promise for achieving the desired transformations at the necessary scale and speed" (GSDR 2019: xxi). This report identifies six thematic areas as imperative to sustainable societal transformation, namely: 1) Human well-being and capabilities, 2) Sustainable and just economies, 3) Sustainable food systems and healthy nutrition, 4) Energy decarbonization with universal access, 5) Urban and peri-urban development, and 6) Global environmental commons.

Each participant who signed up for Transformation Labs online registered under one of these six entry points. Likewise, the structure of this idea catalog is based on these six entry points. Each chapter presents the ideas suggested within the six different entry points. Although each group focused on one specific entry point, they cannot be separated neatly from one another. The participants were therefore encouraged to reflect on the possible synergies between the other groups' ideas. We hope that the entry points collectively outline steps toward a tangible path to global sustainable transformation, and ecological and humanitarian resilience.

Levers

For the purposes of the Transformation Labs process, we have conceptualized a lever as a key element that influences the functioning of the human system. The 2019 GSDR report identified four levers that run through, and direct, the implementation of initiatives across all six entry points. The levers are: 1) Governance, 2) Economy and finance, 3) Individual and collective action, and 4) Science and technology. According to the 2019 GSDR report, these levers "accommodate the multiple, complementary roles that individual actors and entities play in bringing about change" (GSDR 2019: xxi). Therefore, all groups were asked to consider these four different levers and their influence on the proposed ideas and initiatives.

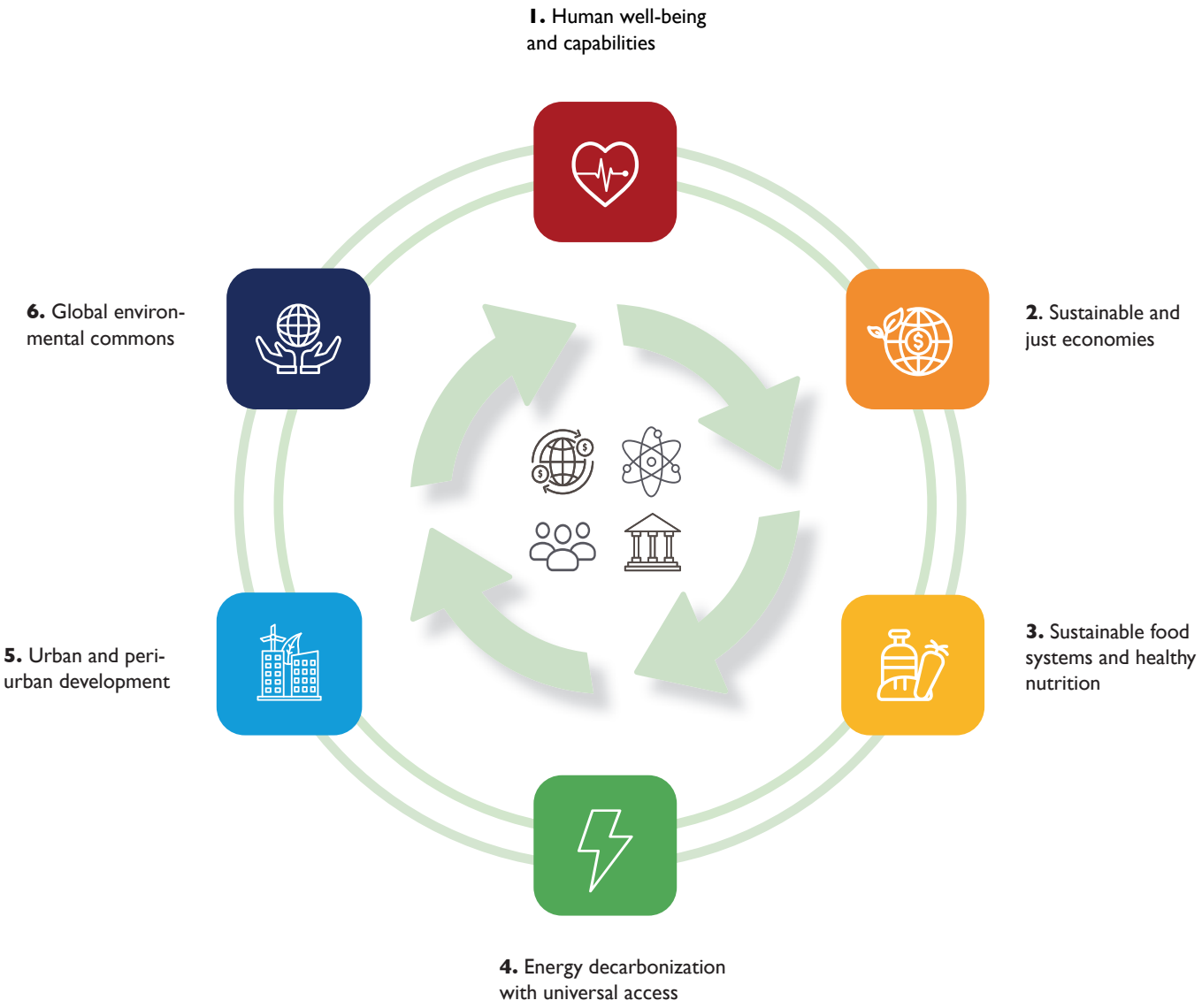

Figure 2 - Interconnection of Levers and Entry Points
Inspired by Figure 2-2 (Pathways to transformation) in the GSDR report (United Nations, New York, 2019, p. 29).

The Four Levers

- Governance
- Economy and finance
- Individual and collective action
- Science and technology

Facilitators, participants, and expert speakers

Each working group was moderated by one to three early-career facilitators who directed the discussion and were responsible for formulating and finalizing the ideas into the idea catalog. The facilitators were also responsible for gathering feedback and input from the participants during and between discussion sessions. To supplement knowledge needs within the working groups, the facilitators invited selected expert speakers to join the three discussion sessions. These speakers provided feedback and suggestions for refinement of the developing ideas. Additional input was gathered from a range of experts who could not participate in the sessions. At the end of the catalog, we have included a list of acknowledgments thanking the people who helped us make Transformation Labs a success.

Moreover, Professor Imme Scholz and Dr. Nancy Shackell from the 2023 GSDR Independent Group of Scientists joined us for the kickoff event to engage in dialogue with Professor Katherine Richardson. The discussions centered around the challenges and opportunities related to sustainable transformations in a fast-paced and ever-globalizing world. These two talks collectively inspired the following discussions in the groups.

Maturity levels, context, and scale

To evaluate each idea's maturity status, we developed a maturity scale moving through five different maturity levels: 1) Idea generation, 2) Early development, 3) Small-scale implementation, 4) Moving to scale, and 5) Implemented broadly. In addition to the maturity status assessment, we also included short reflections on the potential beneficiaries and opponents to each idea. Accordingly, we asked all participants to provide examples of cases where the idea had already been tested. This also included reflections on whether an idea is context-specific or globally implementable, and at what scale the idea is envisioned to be implemented.

Behind the scenes of Transformation Labs Kickoff event streaming from GRØN (Copenhagen University) 22nd of February 2023

Reading guide

The catalog is divided into sections according to the entry points. All ideas have been aligned to adhere to the same format. You will be introduced to each entry point and then each idea. Due to the interdisciplinary nature of the working groups and the holistic aim of incorporating all four levers into all six entry points, the ideas have not been separated into e.g. societal, political, and technical solutions, but instead present the research first and its relation to the levers second. Lastly, this is not an exhaustive list of possible solutions to the global environmental crises, but a selection of ideas which surfaced within an experimental and open dialogue across disciplinary, social, and geographic borders. Therefore, we encourage and support future endeavors to further our work by building on the lessons learned from our experiment.

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GDSR 2019. Global Sustainable Development Report: The Future is Now – Science for Achieving Sustainable Development, (United Nations, New York, 2019)

ENTRY POINT 1

Human well-being and capabilities

Human well-being has been the core aim of development since the global community's adoption of the human development framework in the 1990s, if not earlier. However, differing and siloed conceptions of human well-being and the expansiveness of the sustainable development agenda (specifically, the SDGs) have led to uneven and inequitable achievement of human well-being – resulting from over-emphasis of certain goals (e.g. economic growth, industrialization, urbanization) at the expense of others (e.g. economic security, psychosocial well-being, and community cohesion). Thus, the Human well-being and capabilities group proposed ideas that aim to re-orient the sustainable development agenda toward improving human well-being so that no one is left behind (as called for by the SDGs).

Drawing on the experiences and perspectives of more than 10 participants from different cultures and disciplines, the group engaged in a dialog ranging from philosophical questions of how (and whether) to define an existential notion such as human well-being to practical ways to meet the currently unmet needs of many human beings globally. Lively (and not uncontentious) discussions led the group to a holistic, empowering, and pluriversal conception of human well-being – one that promotes positive pursuits of "good lives" as envisioned by diverse and empowered communities rather than mere negative eradication of poverty and misery. At the same time, despite cultural and disciplinary diversity, all members of the group agreed on the critical importance of sufficiency in the sustainable development era. This means that human well-being for all can only be achieved if we accept limits on excessive consumption that impede the well-being of humans, non-humans, and the planet.

This Transformation Labs journey culminated in four concrete ideas that we believe are ready to be implemented and have the potential to advance human well-being for all, within planetary boundaries. The first idea situates human well-being within the limits of sufficiency and planetary well-being, and then proposes that such a notion of human well-being be prioritized as the foremost "end" or "goal" within the currently over-expansive SDG Agenda. The second idea proposes an innovative approach to education that exposes students to "real-world" challenges and encourages them to explore these creatively. The third focuses on the interconnectedness of human and planetary well-being by demonstrating how bottom-up initiatives on two of Taiwan's islands are pursuing planetary well-being by balancing human-nonhuman relationships following overwhelming impacts of tourism. The fourth idea seeks to catalyze behavioral change through demonstration projects and storytelling, which shift the societal narrative away from competition and consumption to sharing and psychosocial fulfillment.

Group facilitators

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a. Narratives and two hours for the future

Description

To move toward a more just, regenerative, and sustainable future, we need a discursive shift away from neoliberal narratives that link human well-being (HWB) to "more" (consumption, status, and wealth) toward a conception of HWB that recognizes sufficiency (i.e. HWB within an environmental ceiling, as described in HWB idea b) and "sharing" (also referring to the recognition of our mutual interdependence). Narratives developed via small-group discussions and bottom-up activities have proven to be transformative in many fields, including social psychology (Bliuc and Chidley 2022), policy implementation studies (Torry 2022), deliberative democracy studies (Lupia 2002, Chambers 2018), environmental change studies (Reed et al. 2017), group studies (Swim and Bloodhart 2018, Fritsche and Masson 2021), positive peace studies (Nadler and Schnabel 2015, Staub 2014), and group narrative studies (Novac, Zahn, and Blinder 2022).

However, current dominating social narratives are dystopian, tech-optimistic, and/or projections of neoliberal business as usual (Riedy 2021). If no other narratives are available to help people imagine different futures, these dominant narratives will set the boundaries for how our society will function and evolve. Thus, this idea proposes a spur of "discursive entrepreneurship" to "guide an ethical practice of meaning-making towards discursive transformation" (Riedy 2021: 541) – indeed, toward a more just, regenerative, and sustainable future.

We propose a two-fold project:

1. Shift the narrative from "more" to "share": This initiative invites people to create and share real-life and imagined narratives about how communities of people live well while respecting planetary boundaries and not infringing on others' ability to live well. We will collect and share such visions of regenerative and just HWB – building on the "pluriverse" of "ways of living" (Kothari et al. 2019). By helping people imagine that there are good lives waiting in the regenerative future, we set them free to pursue these lives. The narratives will be engagingly documented via animations, soundscapes, essayistic podcasts, short stories, interviews, and other artistic formats, and shared via diverse channels to reach a wide audience, including policymakers, educators, community leaders, and the public. Dissemination methods could include social media campaigns, public events, workshops, and collaborations with existing networks and organizations working toward sustainability and well-being.

2. Two hours for the future: Concrete real-life examples of sustainable/just HWB can motivate others to experiment and change their own behavior. We propose to spur a bottom-up movement of people (researchers, CEOs, board members, private-sector employees, public servants, celebrities, pensioners – people from all parts of society) working toward bringing the narratives into reality. We will challenge each adult to spend two hours per week on any task that contributes to realizing a just and sustainable future. Our guidelines read as follows: (a) Two hours should be spent as part of a group to foster community and collective action; (b) two hours should be spent on work that is at least a bit different from that which the person gets paid to do; (c) we would challenge every employer to allow employees to use work time for Two hours for the future.

To ensure that narratives and actions (undertaken as part of Two hours for the future) are indeed "just" (do not transgress HWB) and "sustainable" (do not transgress planetary well-being [PWB]), these should adhere to the HWB and PWB standards proposed by idea b. "Prioritize human well-being within the SDG Agenda", as found in this entry point. These two parts – Shift the narrative from "more" to "share" and Two hours for the future – are interrelated and mutually reinforcing. Shift the narrative from "more" to "share" provides inspiration and ideas for how people will spend their Two hours for the future. Then, as more people spend time transitioning to just and sustainable ways of living, there will be more narratives to share which can inspire yet other people to act. Consequently, this idea transforms governance by self-organizing deliberative democracy and by activating citizens. People can thereby regain agency over concepts such as economy, finance, science, technology, sustainability, and development – and reshape them to build the society that they desire independent of policies and ideologies imposed from above. Well-articulated narratives of desired futures clarify and signal which technological developments we need, as well as what is undesirable and unnecessary.

Context and application

This is a global idea that needs to be implemented simultaneously by communities in the Global North and Global South. Simultaneous action is key, as we need to collectively realize our interdependency, and that one's overconsumption (in the name of our well-being) can reduce or prevent the well-being of others. Given the different cultural and socio-economic contexts, Shift the narrative from "more" to "share" and Two hours for the future are likely to be quite diverse. For example, groups in underconsuming areas might develop narratives and actions that create hope and increase well-being, while groups in overconsuming areas might focus on narratives and actions that can help their communities realize that it is in their own interest to share and not transgress human and planetary boundaries.

Relevant actors

Explorations of appealing, regenerative futures are already being undertaken, drawing on visioning, imagination, group sharing, and world building around what could constitute desirable futures. Work to transform these explorations into narratives is also underway (e.g. Oldin 2023, Kothari et al. 2019, Robinson 2023). A number of these existing narratives are from the Global South, e.g. indigenous philosophies such as the Zapatistas and Ubuntu and initiatives such as the Gross Happiness Index, which raise the potential of spreading more sustainable and just ways of living from the Global South to the Global North. This idea can and should be implemented by people from all parts of society (e.g. researchers, CEOs, board members, private-sector employees, public servants, celebrities, sports clubs, pensioners etc.). However, top-down facilitation (by governments, employers, international organizations etc.) is also necessary to ensure that sufficient time and resources are freed up to ensure widespread mobilization.

Implementation strategy

1. Form an organizing group (perhaps a coalition of interested civil society organizations) that recruits small groups systematically from communities in the Global North and Global South and sets standards to ensure the quality of narratives and Two hours for the future projects. The organizing group will develop templates and guidelines, such as what types of information to include in narratives and project descriptions to make them useful and appealing to the public; HWB and PWB standards that narratives and projects should seek to advance (and be careful to not transgress); and instructions on how to use the GHH backcasting method, i.e. working backward to develop concrete steps toward desired futures (Willamo et al. 2018) to test imagined futures against scientifically established planetary boundaries.

2. Recruited groups will then produce narratives and commit to Two hours for the future projects on a rolling basis, guided by the standards, templates, and guidelines produced by the organizing group. We envision that Two hours for the future projects will be designed to take steps toward the envisioned futures (narratives). Narratives and projects will be documented and shared via an online platform. These documentaries can then be used to help newly recruited groups design their narratives and Two hours for the future projects. This Transformation Labs idea is one starting point to help groups design narratives and projects.

3. With input from participating groups worldwide, the organizing group will curate and maintain an online platform where individuals and groups can upload their narratives and publicly showcase their Two hours for the future projects. The curated narratives in the form of animations, soundscapes, essayistic podcasts, short stories, interviews, and

other artistic formats – can form a basis for outreach and dissemination of new, co-created stories of life in a just and regenerative future.

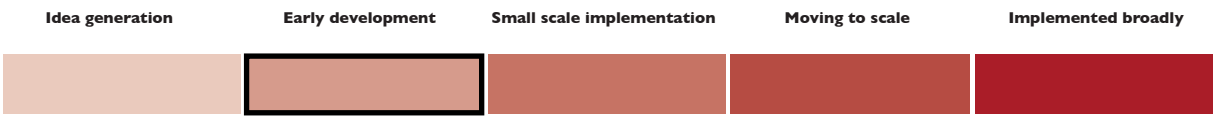
4. Public- and private-sector employers will be challenged to allow their employees to participate in Two hours for the future projects using work time. Participating employers can then challenge other companies to join the effort.

5. Cities, states, and other government entities that support this effort, either as employers or via policy initiatives, will be encouraged to challenge other cities, states, and government entities to join the effort.

Challenges and barriers

There are two main challenges – one logistical and the other substantive. Logistically, this idea can only be realized if an initial group of volunteers (individuals and/or groups) begins implementing the initial tasks described in the implementation strategy section. Two participants from the Human well-being and capabilities group are exploring the possibility of convening a university/research consortium that can launch an organizing group. Substantively, for this idea to make meaningful contributions to accelerating sustainable development, the Shift the narrative from "more" to "share" and Two hours for the future projects must be aligned with HWB and PWB standards. Thus, one of the initial tasks for the organizing group should be to design standards, templates, and guidelines that are scientifically grounded, yet not prescriptive or inflexible. These HWB and PWB standards can be informed by idea b. "Prioritize human well-being within the SDG Agenda", of this entry point.

Maturity



Different ways of living well while respecting others and the planet are already underway, e.g. Zapatistas, Landless Workers' Movement, Ubuntu, Bhutan Gross Happiness Index, Via Campesina in the Global South, and Fridays for Future, Scientists for Future, and Mothers for Future in the Global North. This idea draws inspiration from and expands these existing initiatives. It aims to link disparate initiatives into a global movement, and to broaden awareness of this and related initiatives. If we can address the challenges and barriers described, this idea can begin in2024 and hopefully gain momentum within two-three years.

Success criteria

- 250 narratives and/or projects in 2024 (10 countries).
- 500 narratives and/or projects in 2025 (20 countries).
- 1,000 narratives and/or projects in 2026 (50 countries).
- Increased feelings of social cohesion and trust in participating communities/countries (to be measured via the World Values Survey and/or other global surveys).

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By Erik Mclean via Unsplash

b. Prioritize human well-being within the SDG Agenda

Description

By applying a conception of human well-being (HWB) as the needs and capabilities that people everywhere have reason to value as ends in and of themselves (Alkire 2002; Doyal and Gough 1991; Max-Neef, Elizalde, and Hopenhayn 1991; Millward-Hopkins et al. 2020; Nussbaum 2000; Rao and Min 2018; Sen 1987, 1993), we find that the current SDG Agenda does not prioritize HWB ends above others that are instrumental to HWB (i.e. means to achieve HWB) and/or contested (i.e. might or might not contribute to HWB). A recent review by Voluntary National Reviews (official SDG implementation progress reports submitted by countries) documents the problematic and selective nature of SDG implementation, where hard-fought, rights-based ends, such as HWB and equality, are subsumed, and thus diluted, within the expansive SDG Agenda comprising 169 goals/targets (Kim, Bang, and Kim 2022).

For example, economic growth, industrialization, urbanization, and infrastructure development are means that countries might or might not choose as they strive to achieve HWB ends. These instrumental means are among the 169 SDG targets, and they are given equal priority to incommensurable HWB ends such as healthy life, food, water, shelter, and freedom from poverty and violence. This leads to instances in which certain goals/targets implemented by countries – sometimes even ostensibly with the aim of enhancing HWB – decrease (rather than increase) HWB. Numerous studies have documented negative impacts of economic growth, trade, agriculture intensification and modernization, and infrastructure development on health, food and nutrition, access to water, decent work/livelihoods, adequate shelter, and poverty (see e.g. Fader et al. 2018; Frey 2017; Golden et al. 2019; Woodward 2015).

The SDG Agenda's lack of prioritization of HWB ends also applies to planetary boundaries. While the SDG Agenda includes targets aimed at ensuring that countries respect planetary boundaries, these targets are not prioritized. They are treated as equivalent to targets such as economic growth, agricultural intensification and modernization, urbanization, and infrastructure development, which have been documented to be inconsistent with environmental targets such as reducing greenhouse gas emissions, biodiversity loss, and air and water pollution (Chen et al. 2022; Griggs et al. 2017; Mulligan et al. 2020; Pradhan et al. 2017). Thus, we propose a re-orientation of the SDG Agenda to prioritize HWB and respect planetary boundaries. We propose to apply the Doughnut Economics (Raworth 2017) and Living Well Within Limits (LiLi) (Millward-Hopkins et al. 2020) frameworks, the latter of which builds on

the former. The Doughnut Economics framework prioritizes 11 Social Foundation ends and nine Environmental Ceiling ends. However, based on decades of research and conceptualization of human development and HWB (Alkire 2002; Doyal and Gough 1991; Max-Neef, Elizalde, and Hopenhayn 1991; Millward-Hopkins et al. 2020; Nussbaum 2000; Rao and Min 2018; Sen 1987, 1993), we propose to adapt the Social Foundation dimensions to include: 1) health, 2) food, 3) water, 4) shelter, 5) livelihoods, 6) education and knowledge, 7) voice and dignity, 8) equality, 9) physical and psychological safety and security, and 10) society and community.

As compared to the Doughnut Economics/LiLi framework, we combine "equality" and "gender equality" into "equality"; we combine "income" and "jobs" into "livelihoods"; we re-frame "education" as "education and knowledge"; we replace "resilience" with "physical and psychological safety and security"; we add "shelter"; we add "society and community"; and we drop "energy" (as energy needs are instrumental to, and built into, achievement of the 10 incommensurable HWB ends). These 10 dimensions are depicted in Figure 1 as "HWB Ends". (For further justification of the selection and prioritization of these 10 HWB dimensions, see Kim forthcoming). While the Social Foundation (HWB Ends) is expanded in our model, we maintain the nine Environmental Ceiling dimensions proposed by the Doughnut Economics/LiLi framework, and these are now labeled Planetary Wellbeing (PWB) Ends. Together, these 10 HWB Ends and nine PWB Ends comprise 19 Priority SDG Ends (Kim forthcoming) – corresponding to approximately 20-30 of the current SDG targets. The remaining 149-159 SDG targets – such as agriculture modernization, urbanization, and infrastructure development – as well as alternatives which are not currently part of the SDGs (such as peasant farming, universal housing, and basic income) – should be considered Potential SDG Means (Kim forthcoming) (see Figure 3). The implication is that pursuit of the Sustainable Development Agenda should aim to advance and be evaluated against their advancement of this smaller set of Priority SDG Ends – rather than the current 169 SDG targets which cannot all be realistically and coherently achieved. A given community or country (or any actor pursuing sustainable development) can choose to pursue Priority SDG Ends via any number or combination of Potential SDG Means. However, adherence to Potential SDG Means should not be dogmatic; and most importantly, they should not harm HWB ends.

Context and application

This idea is applicable globally, as it establishes a universal framework around which the SDGs should be conceived, prioritized, and pursued by all actors claiming to contribute to sustainable development, HWB, and PWB. The SDG Agenda itself is already widely accepted, with many societal actors striving to align their actions with the SDGs – or at least characterizing their actions as contributing to the SDG Agenda. However, with this proliferation of actors

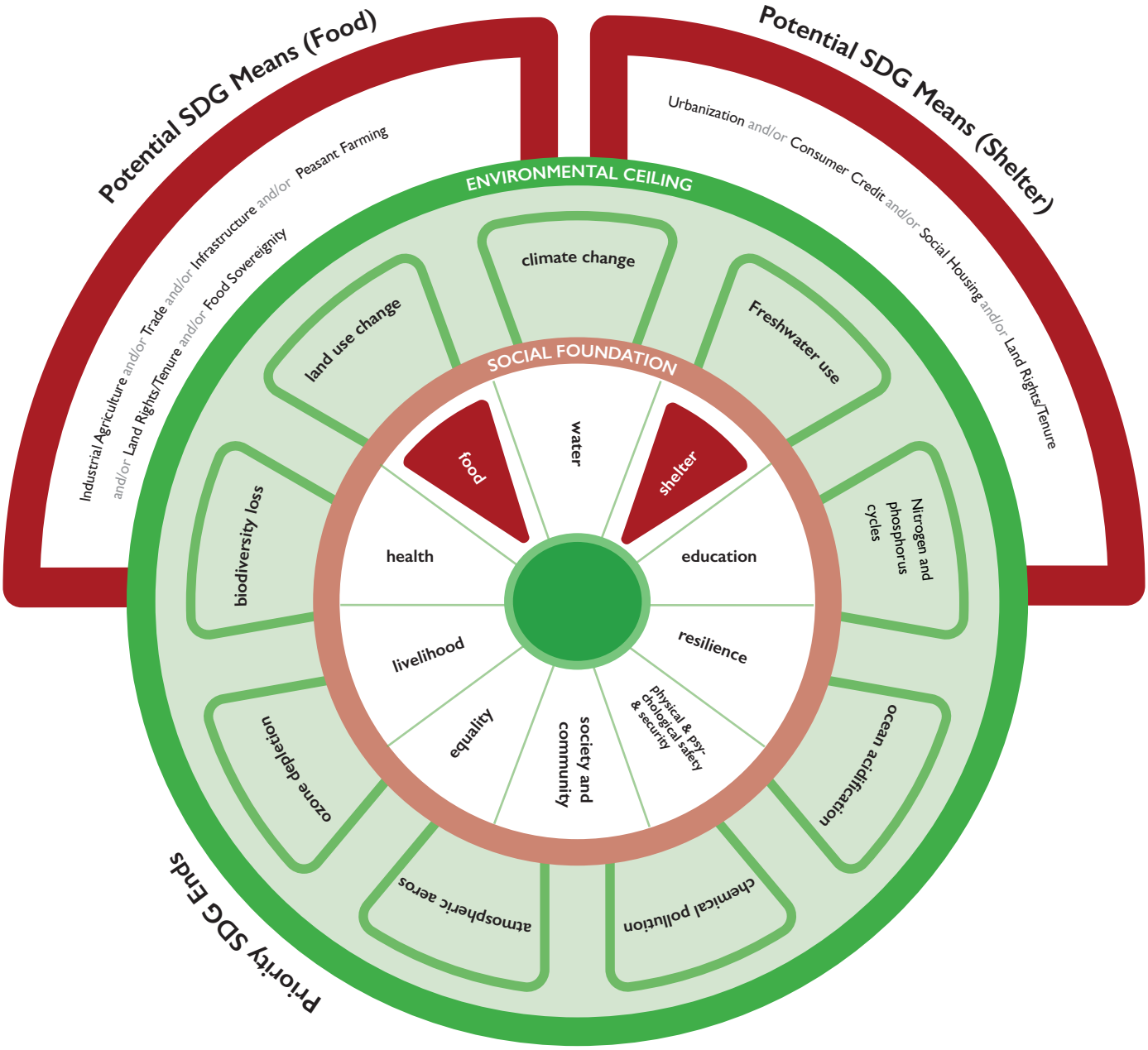


Figure 3 - Priority SDG Ends vs Potential SDG Means (Food/Shelter).
Inspired by ***the Doughnut Economics*** framework as presented by Raworth 2007.

contributing (or claiming to contribute) to sustainable development – and with the SDG Agenda itself inviting non-traditional development actors to do so (via SDG 16: Peace, Justice, and Strong Institutions) – the standards for what constitutes sustainable development have become blurry. Thus, there are many documented cases of actions taken, which advance one or another SDG target, at the expense of other SDG targets. For example, actions taken by G8 countries and their agribusiness companies to commercialize and intensify agriculture have in some instances dispossessed communities of their land, livelihoods, and access to food and water (McMichael 2016; Schiffman 2013; Sulle 2015). Thus, in these instances, achievement of an SDG Means (agriculture intensification/commercialization) is causing harm to several SDG Ends (food/hunger, jobs/livelihoods, land/shelter). The current SDG Agenda enables such undesirable trade-offs and outcomes because it is overly expansive and does not distinguish between instrumental means and incommensurable ends. This proposed re-orientation of the SDG Agenda into Priority Ends and Potential Means, will help ensure that actions taken in the name of sustainable development are in line with the principles of human development and sustainable development agreed on by the development community via international conventions. These conventions include the Universal Declaration of Human Rights, the UN Convention on Economic, Social, and Cultural Rights, the UN Convention on Political and Civil Rights, the Paris (Climate) Agreement, and the Rio Conventions on Biodiversity, Climate Change and Desertification, among others. At least, agreeing to uphold Priority SDG Ends (derived from the aforementioned international conventions) will ensure that those claiming to contribute to sustainable development do no harm to HWB or PWB.

Relevant actors

The main intended beneficiaries of this proposal are human beings, particularly those who are furthest behind in achieving HWB. This is consistent with the SDG Agenda's commitment to "Leave No One Behind" (United Nations General Assembly 2015). Non-human entities will also benefit from the explicit prioritization of PWB ends as well as the pursuit of sufficient HWB within planetary boundaries. The framework should be applied by all development actors who implement activities in the name of sustainable development. This includes traditional and non-traditional development actors such as governments, communities, aid agencies, civil society organizations, researchers, educators, companies, and individuals. There may be opposition from people and groups who currently overconsume at the expense of other people and groups. This includes: countries or communities which externalize their social and environmental impacts on other countries or communities; companies that profit from such externalization and resource extraction; and aid industry actors who benefit from a cycle of aid dependency and/or are dogmatic in certain development ideologies and means (see e.g. Escobar 2011; Ferguson 2006).

Implementation strategy

This new framework Priority SDG Ends + Potential SDG Means can be applied to re-orient existing development processes and tools, including:

1. SDG Agenda: Guided by the High-Level Political Forum for Sustainable Development, SDG signatory countries should develop, shape and refine their SDG implementation plans and reports (e.g. Voluntary National Reports) to address all Priority SDG Ends and consider how their selected Potential SDG Means impact Priority SDG Ends.

2. Aid agency accountability tools: Most aid agencies have accountability tools to ensure that their activities are consistent with their development priorities and globally accepted norms (e.g. Human Rights-Based Approach to Development, Do No Harm, Anti-Corruption, Pro-Poor). Examples of aid agency accountability frameworks include the World Bank Environmental and Social Framework, the IFC Environmental and Social Performance Standards, the European Commission's Human Rights-Based Approach to International Partnerships, the USAID Standard Indicators, and the JICA Guidelines for Environmental and Social Considerations. Aid agencies should review and possibly update their accountability frameworks to ensure that their activities implemented in support of the SDG Agenda are indeed prioritizing HWB and not transgressing PWB.

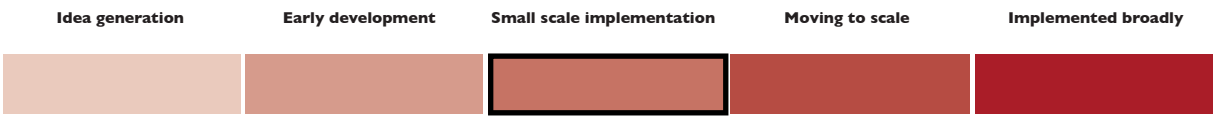
3. Private-sector responsibility tools: For example, United Nations Guiding Principles on Business and Human Rights, the OECD Guidelines for Multinational Enterprises, and the Equator Prinicples. Private-sector frameworks which govern and/or evaluate their contributions to sustainable development should be re-oriented around Priority SDG Ends, rather than the industry standard triple-bottom-line, which considers profit to be an end equal to HWB and PWB.

Challenges and barriers

There may be opposition to this proposal from relatively better-off countries and companies that overconsume at the expense of other people and groups. Thus, a significant challenge will be to get such countries and companies, which are also existing or potential funders of sustainable development actions, on board with this idea's conception of sufficient HWB within PWB. Indeed, the incoherence of the current SDG Agenda stems in part from the inclusion of pro-business and pro-market interests. This idea seeks to convince a critical mass of actors, including such powerful groups, to prioritize HWB and PWB ends over their own profit- and/

or consumption-driven interests – at least when it comes to actions that they undertake in the name of sustainable development. Since implementation of the SDG Agenda is entirely voluntary, it is not feasible to make HWB and PWB ends mandatory or binding. Thus, this idea relies on transparency and storytelling to address the above-described challenge. The intention behind the idea is to make HWB and PWB standards more clear, consistent, and transparently reported (via Voluntary National Reviews, donor M&E reports, etc.) – even if they remain voluntary. This will provide interested stakeholders (citizens, activists, CSOs, researchers, etc.) with the norms and information necessary to hold development implementors responsible to HWB and PWB standards in their own ways (using different types of pressure points and platforms). The idea will benefit from idea a. "Narratives and two hours for the future", as found in this section, which focuses on the importance of catalyzing a discursive shift away from neoliberal narratives that link HWB to "more" (consumption, status, and wealth), and toward a conception of HWB that recognizes sufficiency and "sharing".

Maturity



Our proposed reorientation of the SDG Agenda around Priority HWB and PWB Ends draws on longstanding principles of human and sustainable development which the development community has agreed on via international conventions such as the Universal Declaration of Human Rights, the UN Convention on Economic, Social, and Cultural Rights, the UN Convention on Political and Civil Rights, the Paris (Climate) Agreement, and the Rio Conventions on Biodiversity, Climate Change and Desertification, among others. However, with the proliferation of development actors and agendas – the SDG Agenda being among the most expansive – these rights- and norms-based development standards have been diluted and "sidelined" (Kim, Bang, and Kim 2022). There are some recent efforts to bring HWB ends back to the forefront of development and public policy. For example, a few countries such as Bhutan and New Zealand have linked their national development to HWB. Regionally, the OECD has developed a Better Life Index which measures member countries' progress on HWB. However, these are stand-alone national or regional efforts. This idea seeks to expand these isolated efforts to foster global commitment to HWB and PWB via the SDG Agenda.

Success criteria

- Future GSDR reports recommend Priority SDG Ends (HWB and PWB) and Potential SDG Means.
- Future HLPF reports recommend Voluntary National Reviews to be structured around Priority SDG Ends (HWB and PWB) and Potential SDG Means.
- At least one aid agency adopts Priority SDG Ends (HWB and PWB) and Potential SDG Means within the next three years.
- At least one private-sector responsibility framework adopts Priority SDG Ends (HWB and PWB) and Potential SDG Means within the next three years.

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c. Establish and strengthen citizen-led pressure groups to counter exploitative tourism

Description

Based on research that explores community action countering exploitative tourism on the two Taiwanese islands of Liuqiu and Lanyu (Chang 2020, Chen 2007, Huang 2018, 2022, Yeh 2022) as well as research on the role of bottom-up initiatives in pro-environmental practices (Jans 2021), this idea addresses the potential impact of citizen-led action against exploitative tourism, particularly in biodiversity hotspots across the South Pacific region. The two cases showcase how to pursue mutually beneficial interrelations between humans and non-humans by downscaling tourism through regulations pushed by art, activism, and other citizen-led bottom-up initiatives. These initiatives include patrolling, ocean waste collection, and artistic activism, which started locally and organically with an aim to channel the communities' voices, challenging profit-oriented tourism, to decision-makers in power.

In the past decade, tourism has grown significantly on the two Taiwanese islands. The growing tourism industry is profitable. However, a lack of regulations puts pressure on the two offshore islands' ecosystems and disrupts residents' everyday life. For example, in July 2022, due to an overwhelming number of tourists visiting Liuqiu, the local government imposed water rationing. To take advantage of the limited water resources, local hostels and restaurants built larger water containers, thus undermining residents' well-being, as they had to compete for water with large-scale tourism actors. Water rationing is not the only inconvenience caused by tourism for the islands' residents. Rapidly growing tourism has caused harm to the rich biodiversity of Liuqiu's intertidal zones and endangers the green sea turtle's habitat. 80 percent of biomass has been reduced at the two most popular intertidal zones (Chang 2020). Not exactly improving residents' well-being, tourism creates environmental problems, including pollution and biodiversity loss, for both Liuqiu and Lanyu. After years of waiting, Taiwan's government passed the Ocean Basic Act in 2019. Following increasing pressure from citizen-led, bottom-up initiatives, which started around 2009, researchers and indigenous communities have launched discussions on establishing marine protected areas on Liuqiu and Lanyu. While much is still to be done to meet the islands' human and non-human needs, downscaling tourism to mutually benefit human and non-human well-being exemplifies an alternative social metabolism: slower, but better for locals and their environments. Based on these two examples, we propose citizen-led pressure through bottom-up initiati-

ves, including citizen-led pressure groups, artistic activism, and community-led, volunteer-based conservation or protection methods, as tangible and implementable measures toward improving human and environmental well-being in tourism hotspots. Bottom-up initiatives are valuable in transforming exploitative tourism for several reasons. First, by not being bound to any public sectors, the initiatives have autonomy to react quickly to unsustainable consumption patterns when necessary. They can (and should) take advantage of their autonomy to collaborate with NGOs and develop communication with local business owners and tourists. Second, local experiences are crucial reference points for researchers and policymakers to design and implement more effective policies to balance tourism, residents' well-being, and the health of the environment. Third, by organizing these initiatives, residents may form a unique social identity tightly interconnected with marine culture and ecosystems.

Context and application

While this idea is based on the examples of two Taiwanese islands, we propose that local communities across the world can draw from these experiences as they seek to protect their environment from destruction resulting from exploitative tourism. As our global environment is experiencing increasing pressure due to human activities, it is crucial that all inhabitants of the planet act against any exploitative production and consumption cycles. We consider citizen-led pressure groups to be one effective avenue to persuade both public and private entities to consider the experiences of local communities.

The examples of Liuqiu and Lanyu showcase how citizens, through community mobilizations and community-led environmental protection initiatives, can push local and national governments to consider and implement new policies. Based on these insights, we promote citizen-led, volunteer-based actions against exploitative tourism as a transformative initiative enabling changes and improving human and non-human well-being.

Relevant actors

Unlike the majority of ideas in this catalog, this idea rests primarily on local communities that live in tourism and biodiversity hotspots across the globe. It appeals to the general public to mobilize themselves organically to counter environmental exploitation. Primary beneficiaries are local communities and non-humans living within ecosystems deteriorating due to rapidly growing tourism. On the other hand, potential opponents include private entities with monetary gain from exploitative tourism and decision-makers with an interest in maintaining a status quo.

Implementation strategy

Citizen-led initiatives are often organized by volunteers. These small-scale and often underfunded initiatives need communication strategies and channels to organize events, maintain participant engagement, advocate their missions and goals, and expand their networks with other initiatives at local, national, and global levels. However, as this idea proposes organic, citizen-led formations, each formation has its own unique framework. Therefore, a concrete blueprint for implementation is not possible or realistic, given the peculiarities of any context where this idea may be applicable. Below, we have presented a selection of lessons learned during our group discussions of the two cases of Liuqiu and Lanyu.

Education: Raising public awareness of environmental sustainability requires the support of educational systems and established civil movements. Through different forms of activities, citizen-led initiatives can show tourists that changing their (consumption) behavior helps decrease human impacts on the environment. For instance, eco-tours organized by the locals provide tourists with different angles of exploring the two islands. Likewise, residents have organized workshops to advocate the importance of preserving Yami's ocean culture through a holistic relationship between humans and non-humans. Concurrently, citizen-led initiatives can collaborate with universities and research institutes to preserve and pass local knowledge on to local communities and future generations.

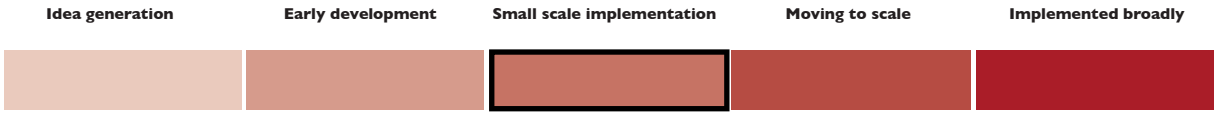
Collaboration and stakeholder engagement: Lack of funding and manpower means that the two islands' current initiatives rely on self-publishing activities, such as blogging, podcasts, and Facebook fan pages, to communicate with volunteers and reach their audiences and participants. Collaborating with similar initiatives or NGOs to co-organize activities can efficiently increase visibility and foster engagement with different stakeholders.

Challenges and barriers

One primary challenge pertaining to the presented idea is that negotiations between the authorities and communities take a long time. In the two cases mentioned above, it took the Taiwanese authorities 10 years to recognize what was happening at the two islands and make changes. Likewise, while community-led dialog turns policy focus toward securing residents' and non-humans' well-being on the islands, much is still to change to halt the increasing tourism pressure. This reveals the inevitable trade-offs characterizing negotiations between local communities and their authorities. Another primary challenge is to organize community-led pressure groups, as was done on Liuqiu and Lanyu.

Indeed, mobilizing people to join organically developed citizen-led pressure groups requires initiators within communities who can bring people together to discuss their grievances, concerns, and hopes for the future. Idea d in this entry point and idea d in entry point 2: Sustainable and just economies, describe two different modalities that could lead to the formation of citizen-led pressure and advocacy groups.

Maturity



Community-led advocacy and activism is far from a new development and has historically led to significant changes to how human society is structured. Research on the role of bottom-up initiatives in pro-environmental activities explains that grassroots and local community initiatives enable residents to form their social identity by organizing initiatives that build on principles of up keeping a holistic environment for humans and non-humans (Jans 2021). The two cases of Liuqiu and Lanyu reveal the significance of community-led pressure and negotiation with regard to changing environmental destruction caused by exploitative tourism. While such initiatives are numerous in examples, they most often happen in small or isolated localities in lack of broader coordination of similar initiatives. We therefore suggest that any citizen (group) engages with similar initiatives from around the world, learns from best practices, and creates a global momentum pushing for change from below. Such organic initiatives may also inform the remainder of ideas in this catalogue that address the need for increased citizen participation in decision-making.

Success criteria

- Uptake of community-led pressure and advocacy approaches as a tool to create sustainable transformation in tourism hotspots.
- An alternative social metabolism – slow down the profit-oriented tourism and encourage a more sustainable cycle of production and consumption – practiced and implemented to reshape local tourism and enhance the environmental awareness among the locals through workshops and social media.
- Increased willingness among local, national, regional, and international authorities to partake in dialog with their constituents on issues of human well-being and environmental health.

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d. Incorporate the quadruple and quintuple helix models into educational policy

Description

This idea proposes an incorporation of the quadruple and quintuple helix models into educational policies across the world to foster a greater synergy between classroom education and the future challenges students will face as they become part of the workforce. During the group discussions, a central sentiment was the need to foster principles of human well-being, starting from the early childhood development and further throughout a person's educational trajectory. It was emphasized that a stronger level of coherence is needed between what is taught in the classroom and what is expected after a person has finished education.

One attempt at creating such coherence between education and challenges of the real world outside of the classroom is the quadruple helix model (Carayannis and Campbell 2009) and its updated version, the quintuple helix model (Carayannis, Barth, and Campbell 2012). The aim of these models is to ensure a coexistence and synergizing relationship between various forms of knowledge and modes of knowing. In its original formation the quadruple helix model demonstrated this by stressing the interdependency of the four helixes: academia/university, industry/business, state/government, and media-based/culture-based media. According to Carayannis and Campbell (2009), these different spheres of interest (and knowing) all hold keys to transforming our global society into a knowledge-based economy with optimal innovation potentials, through shared knowledge and experiences across sectors. In addition, Carayannis, Barth, and Campbell (2012) added a fifth helix, namely natural environments of society, thus constructing the quintuple helix model in light of our current Anthropocene condition. Both models will from hereon be referred to as the QH models. In our group discussions, it was suggested to actively incorporate the principles of these knowledge models within educational policies across the world. This incorporation is seen as fruitful to foster alliances between educational institutions, private industry, public and state entities, media, and civil society entities, and with the natural matrix in which the first four helixes are all embedded.

Context and application

This idea pioneers by bringing the QH models into an interactive framework within the educational arena. That said, the QH models have proved their efficiency by fostering cross-sectoral alliances across the world. One example is the European Innovation Partnership (EIP) initiative

for smart cities and communities, which, based on the QH models, developed innovative solutions for sustainable urban development (Selada 2017). Similarly, the QH models have been applied in the Taiwan Bio-development Initiative (Wong 2005) and to address food security in Africa, for the African Agricultural Technology Foundation (AATF) (Boadi and Bokanga 2007).

We propose that the QH models in educational policy are enhanced by utilizing the campus as a living lab (LL) that acts as a real-life ecosystem, designed for open innovation and dialog amongst students and a diverse set of professional actors or institutions. LLs are real-world test and experimentation environments that promote co-creation and open innovation (European Network of Living Labs n.d.). By utilizing information technology, interactive and engaging learning environments are promoted and improved by means of a variety of tools and platforms for collaboration, communication, feedback, and personalization. Such technologies include virtual reality, artificial intelligence, gamification, and block chain, all of which can enhance the learning experience and the outcomes of the education model by creating immersive, adaptive, and secure learning spaces that support the development of human skills and competencies. In a nutshell, this idea promotes the development of knowledge-sharing platforms, internship programs, collaborative research projects, and industry involvement as part of curricula. To fully realize the potential of this proposal, it is necessary to develop legislation and ensure that all members of society adhere to its principles. Creating an environment that fosters innovation and education requires effective governance. This can be achieved through collaboration, resource provision, and rule-setting, thus, making investments in education and research a prerequisite for achieving this idea.

Relevant actors

The proposed idea involves collaboration among all human actors listed in the QH models, including collaboration with the natural environment around them. In the following, some of the most crucial actors constituting the five helixes of the models are listed:

- Academia: educators, researchers, and students who provide knowledge, skills, and creativity for educational innovation.
- Industry: entrepreneurs, employers, and employees who offer resources, opportunities, and challenges for educational innovation.
- Government: policymakers, regulators, and administrators who create the legal, institutional, and financial conditions for educational innovation.
- Civil society: NGOs, media, and citizens who represent the values, needs, and interests of a society for educational innovation.
- Natural environment: ecosystems, biodiversity, and climate that influence, and are influenced by, educational innovation.

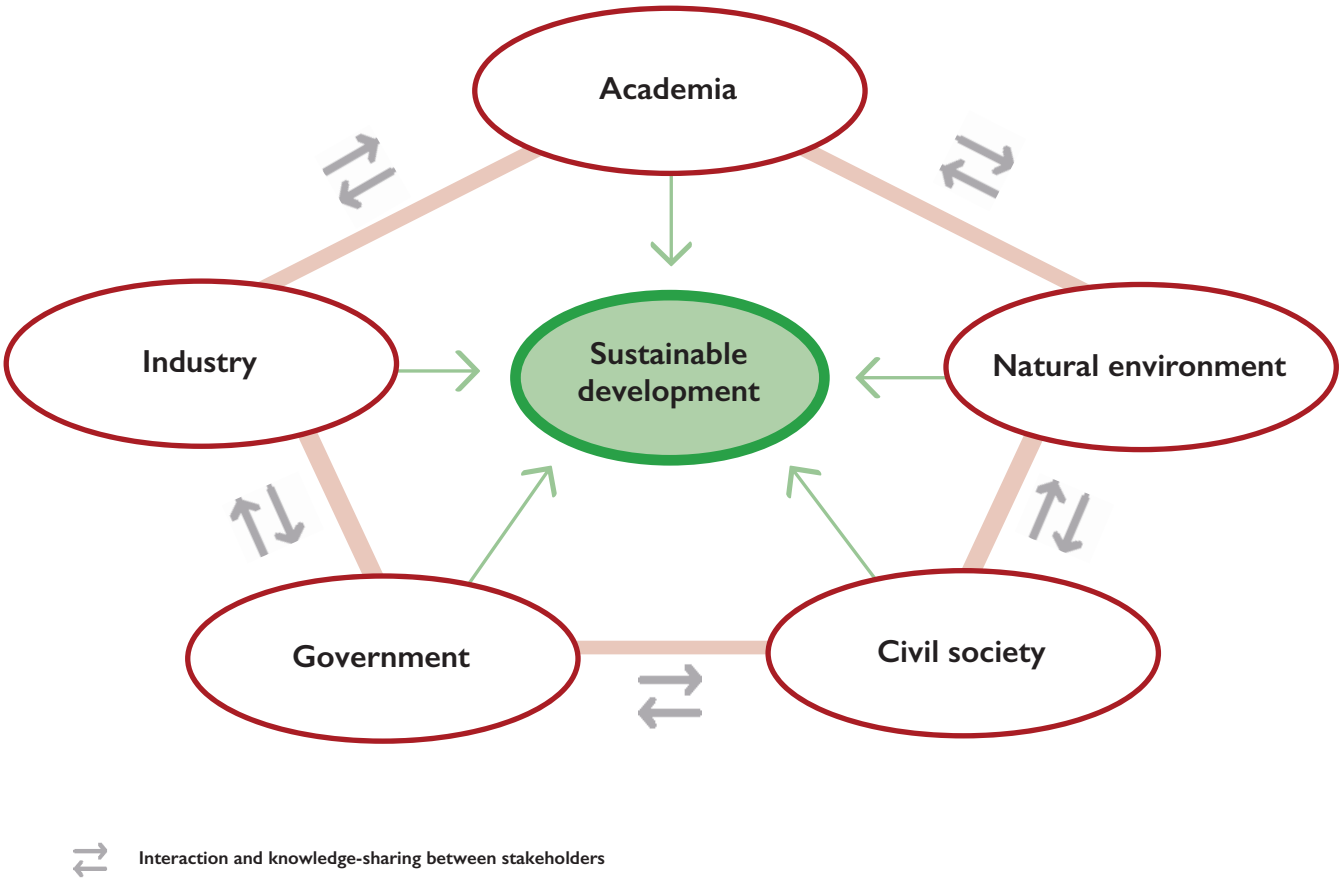


Figure 4 - The Quintuple Helix Model. Inspired by *Figure 4: The Quintuple Helix model and its function (functions)* as presented by Carayannis, Barth & Campbell, 2012 p. 7.

Implementation strategy

Our proposed idea aims to foster a culture of creativity and collaboration among different stakeholders, particularly between students and professionals. We have developed the following go-to implementation strategy to provide inspiration on how this idea can be brought into fruition. This has been divided into the following seven phases of implementation:

- **Phase 1** (Policy development): Development of policies and guidelines for integrating the QH models into educational systems. Consider necessary adjustments to existing regulations to accommodate for collaborative teaching methods that go beyond a fixed or predefined course curriculum.

- **Phase 2:** Curriculum design and development: Encourage interdisciplinary approaches and critical thinking among students to foster innovation and inspire them to think beyond what they are taught. It is important to consider their existing knowledge, abilities, attitudes, and beliefs when designing the curriculum. Idea a. "Narratives and two hours for the future", presented in this entry point can play an operational role in this phase, as this initiative aims to gather and organize people from various backgrounds into direct collaboration on societal issues. Such forums can be directly drawn upon, as a pluriversal knowledge and educational system is developed (see also Paulson 2019).

- **Phase 3:** Teacher training and professional development: Introduce educators to QH methodologies, emphasizing collaborative learning, innovation, and technology use to connect students with industry experts, government officials, and civil society organizations.

- **Phase 4:** Partnership building: Encourage partnerships that address contemporary problems while fostering civic skills. This also involves developing reciprocal collaborations between schools, universities, and communities (Hartley and Huddleston 2010).

- **Phase 5:** Pilot programs and evaluation: Test the proposed approach in schools and universities via pilot programs and use LL methodologies to gauge effectiveness in real-life contexts with end users (Coorevits, Georges, and Schuurman 2018).

- **Phase 6:** Scaling up and integration: Gradually scale up the use of QH frameworks in educational institutions after successful pilot programs. Monitor integration closely for consistency and quality. Allocate sufficient human and financial resources to support expansions.

- **Phase 7:** Continuous improvement and adaptation: Promote continuous improvement and adaptionin education by reviewing and refining the QH models to address new challenges and opportunities in education and intersectoral collaboration.

Challenges and barriers

- Lack of awareness: Stakeholders may be unfamiliar with the underlying principles and potential benefits of the QH models in educational policy. To address this, we recommend launching awareness campaigns, organizing training programs, and collaborating with educational associations. Such initiatives facilitate the dissemination of the models among key stakeholders, thereby promoting their adoption and implementation.

- Resistance to change: Implementing new educational models requires significant changes to existing teaching methods and institutional structures. This challenge can be addressed by piloting the model in a small-scale setting which will also allow for showcasing of best practices and successful experiments with the models.

- Limited resources: To implement the idea successfully, substantial resources such as funding, infrastructure, and personnel are required.

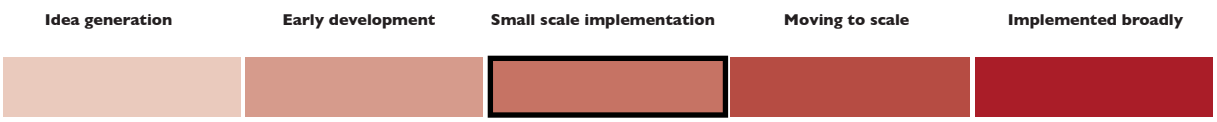
- Institutional silos: Collaboration between academia, industry, government, and society can be challenging. Creative collaborations, including public-private partnerships, between private companies and universities on research, product development, and other projects may help address this challenge. Likewise, introducing younger students to knowledge from outside academia may result in novel avenues toward dialog and (unconventional) collaborations.

- Regulatory barriers: Educational systems are often highly regulated, and implementing the proposed idea may entail changes related to educational policy and regulations. Researchers have pointed out that regulatory barriers and policy changes can be overcome by creating a conducive environment for stakeholders to collaborate and work together (Carayannis, Campbell, and Grigoroudis 2022). This can be achieved through the establishment of a legal framework that supports the restructuring of an educational system. The framework should be designed to encourage innovation and creativity while ensuring that the interests of all stakeholders are protected and considered.

- Cultural differences: Adapting the QH models to different educational contexts requires engaging local communities, respecting cultural values and traditions, and tailoring curricula and learning experiences to be culturally sensitive and relevant. This can be achieved through the development of a conceptual model of cross-cultural alignments in education in a digitalized and globalized age (Shonfeld et al. 2021).

- Equity concerns: Ensuring equal access to opportunities for all members of society can be challenging. To promote equity and inclusion, different strategies include: embedding equity and inclusion in educational policies, establishing a flexible and responsive educational system, including equity and inclusion in targeted funding, and developing the skills of teachers and stakeholders to promote equity principles in education (see also OECD 2023).

Maturity



In the field of education, the QH models are gaining momentum with more institutions and educators incorporating them into their teaching and learning practices. However, the level of maturity varies depending on the context. Some institutions in the EU have fully embraced the QH approaches, while others are still in the process of exploring their potential benefits. The MED-QUAD project (2021) is an example of a small-scale implementation of the QH framework; here the project partners implement actions to support innovation and sustainable local development among universities in the EU and the Middle East. Overall, the QH approach is a promising concept that has the potential to enhance collaboration and innovation in education. However, its level of maturity is still evolving, and further research, monitoring, and evaluation is needed to fully realize its potential.

Success criteria

- Enhanced intersectoral collaboration: The success of stakeholder collaboration can be measured by joint projects, communication frequency, trust levels, and perceived effectiveness.
- Increased innovation: This model fosters innovation by utilizing each actor's strengths and resources through dialog and collaboration. Success can be measured by the quantity and quality of new creations as well as by awards and patents received as a direct or indirect result of incorporating QH principles into educational policies.
- Improved education: The idea aims to improve education through real-world engagements and experiences. Success is measured by student engagement, quality outcomes, and career competencies.

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ENTRY POINT 2

Sustainable and just economies

The creation of sustainable and just economies is a key element in moving toward a socially and environmentally sustainable future within planetary boundaries. However, when thinking of sustainable and just economies we are confronted with certain tradeoffs. One example is the issue of global energy poverty across the Global South. As a result of the current environmental crisis, there is increasing advocacy in the international community for a broad global transition away from fossil fuels. This leaves many states across the Global South in a dilemma. They must weigh concerns regarding the long-term consequences of CO_2 emission against the immediate growth of production and human prosperity that may result from utilizing carbon-based resources. Issues of global inequality and our multiple environmental crises are thus directly interlinked; addressing one will also impact (at times for better, at others for worse) the other.

Our group stressed the need for both radical and context-specific economic change to curb our global predicament. In what follows, we have listed five ideas that may bridge the gap between solving issues of global inequality, on one hand, and addressing our environmental crises, on the other. While these suggestions and their material manifestations alone will not solve our planetary crises, they all offer a push in the right direction, both as isolated ideas and as a collective whole. This said, our discussion went far beyond these specific ideas and suggestions. It was widely agreed that adequate global action for justice and sustainable transition requires a fundamental shift in how we, as a species, approach economics. A common sentiment was the need for a fundamental economic paradigm shift toward a conception of economy that values the material, social, and psychological well-being of all actors in the planetary environment.

The following ideas are all steps that can be taken to reach this goal. All ideas are collectively based on the different participants' backgrounds and fields of expertise. Similarly, this resonates with the content of these ideas, which are products of interdisciplinary discussions and negotiations by people from various ranks, disciplines, and geographic locations.

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a. Supporting and promoting circular economies

Description

We propose intensified support to and promotion of circular economies (CE) globally through collaboration between states, consumers, and businesses. While CEs are spreading, in various shapes and forms, the focus is disproportionately on recycling and not on reduction of gross consumption, production, and extraction globally. Across the world, new forms of economic engagement are taking place. Efforts aimed at creating and supporting CEs have mushroomed since the 1970s (Geissdoerfer et al. 2017). These are envisioned to make sustainable development tangible and operationalizable, particularly for business entities interested in partaking in sustainable development (Kirchherr, Reike, and Hekkert 2017). Geissdoerfer et al. (2017) describe CEs as "a regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling" (Geissdoerfer et al. 2017: 759). Initiatives toward this objective are multiple and differ greatly in both shape, scale, and impact. That said, they largely happen independent of each other and could benefit from more systematic and collective efforts. Such efforts must be geared to steer entire supply chains toward circularity and make recyclable materials and ethical production methods more profitable options for businesses. This also entails adjusting policies and legislation, on various levels, to promote CE principles (Kirchherr et al. 2017). This may prove difficult, particularly in the Global South where formal CE policies are rare. It is crucial that production and resource extraction remains within planetary boundaries and does not jeopardize the well-being and prosperity of generations to come. One tangible way of achieving this is to promote, strengthen, and synergize CE efforts and align these with positive experiences from across different scales, contexts, and locales.

It is important to support a widespread and context-specific implementation of CE initiatives while considering the economic, social, and political peculiarities of individual countries and regions. CEs are not new, and there are many examples from across the world. These range from the conversion of plastic waste into bricks in Nepal (UNDP 2021) to the conversion of organic kitchen waste into biogas in major European cities (see also entry point 3 in this catalog). These examples show the wealth of inspiration to be drawn from across the globe. They also highlight a need for international collaboration and dialog to gauge the synergizing potentials of existing CE initiatives as they are organically developed in both the Global South and North (see also: Corvellec, Stowell, and Johansson 2022, Calisto Friant, Vermeulen, and Salomone 2021). First,

such collaboration will ensure that CE initiatives are aligned along the spheres of extraction, production, and consumption. Second, global alignment will enable knowledge and experience transfers, which allows us to create parameters for measuring and signaling circularity.

Global supply chains need to be considered and incorporated into a sustainable circuit of production, recycling, refurbishing, and reduction. This hinges on a global coordination of CE initiatives, which incentivizes both producers and consumers to opt for products that form part of a clearly defined recycling circuit, and which are made with due consideration to quality and durability. Transparency of global supply chains is crucial and may require global policy adjustments to inform consumers of the impact of their consumption choices.

Many corporations that proclaim adherence to CE principles have focused primarily on recycling, while reduction in consumption and production is often left unconsidered. This may be explained by potential growth disadvantages followed by lowered consumption (Kirchherr, Reike, and Hekkert 2017). Likewise, many corporations give disproportionate attention to the environmental aspects of CEs, while social concerns (such as workers' rights, community degradation because of corporate activities, and social dumping) are disregarded or even neglected (Kirchherr, Reike, and Hekkert 2017, Calisto Friant, Vermeulen, and Salomone 2021, Corvellec, Stowell, and Johansson 2022, Geissdoerfer et al. 2017). To address our current planetary predicament, it is imperative that CE initiatives balance environmental and social considerations toward a holistically sustainable equilibrium that considers the environment with its entire spectrum of species – including humans. This also entails a reduction in general human consumption, which we need to factor into our economic system, thinking, and behavior.

Context and application

Initiatives to spread CE principles often happen in isolation. We therefore recommend conducting a systematized review of CE efforts with a view to practically coordinating their synergizing potentials and harnessing best practices from around the world. Many national and international initiatives are made to promote CEs, and we recommend that these plans and policies are coordinated and aligned. These include the EU's new Circular Economy Action Plan (CEAP) of 2020 (European Commission 2020) and the Circular Economy Promotion Law of the People's Republic of China from 2018 (UNEP 2018). Political differences aside, we must accept the interconnectedness of our world – particularly on the nexus between production and consumption. We urge policymakers and lawmakers to make coordinated efforts toward global transparency of supply chains, which shall enable consumers to make informed decisions and incentivize businesses to invest in environmental and social sustainability through CE initiatives. This is also partly addressed by idea e of this entry point, proposing

global regulation on sustainability reporting. It is important to note that CE initiatives have gained mainstream traction globally and thereby represent a tried and proven concept (albeit on relatively small scales), which can be realistically upscaled and aligned on an international scale. That said, if we are to achieve global sustainability, CE initiatives must be complimented by other tools, such as the remainder of the ideas presented in this catalog. Lastly, it is important to mention that global inequality leads to varying capacities to advance CE systems across the world, and global redistribution, as addressed in idea b of this entry point, is a precondition for securing proper mechanisms of circularity across global supply chains.

Relevant actors

Policymakers and decision-makers tasked to regulate and support corporate efforts to transition toward CE principles are crucial actors. Businesses and producers are equally central to the spreading of CEs, as the concept requires increased global uptake to be considered a success. Lastly, consumers and the broader public are key players, as they shape demand patterns and hold the position to object if they observe immoral or unethical conduct on the part of governments or corporations. Consumer demand and public pressure are therefore crucial when it comes to convincing governments and corporations of the necessity of creating just and sustainable economic systems, e.g. through increased uptake of holistic CE models. Likewise, for CEs (and similar initiatives such as sharing economies) to work, there must be a sense of collective responsibility on the part of both consumers and producers. One historically successful and significant example of a CE initiative with broad national adaptation is the Danish deposit and return (pant) system, which in 2023 "reached zero expenses for producers and 100 percent economic circularity" (State of Green 2023). This, and other successful CE systems, should be analyzed to understand how both consumers' and producers' willingness toward circularity can be cultivated.

Implementation strategy

The idea of creating CEs has already been adopted in various forms. We encourage policymakers and decision-makers to support a process of strengthening these scattered initiatives and envisage their synergizing potentials. We encourage a widening of the notion of CEs to not only embrace recycling within supply chains, but also increase direct efforts toward reducing consumption of resources, while ensuring human and environmental well-being throughout global supply chains. This can be done through regulation, e.g. by regulating practices of "planned obsolescence" (Kramer 2012), which exacerbates overproduction and consumption, or by incentivizing sustainable consumption and production through e.g. tax reductions on durable and sustainable products. Simultaneously, we recommend that busi-

nesses and governments, across scales, coordinate these initiatives in consultation with the greater public to ensure ethical corporate conduct and an increased sense of democratic influence and participation across our global society (see also idea d of this entry point).

Challenges and barriers

In CEs, we must not only recycle resources, but also broadly reduce the resources extracted and used and the products produced. However, it has been noted that many corporate CE initiatives are more focused on recycling than on reductions in production output. Some argue that this is because reduction entails decreased corporate growth (see also: Kirchherr, Reike, and Hekkert 2017). Our idea c of broadening the conception of economic growth and prosperity beyond GDP is, in part, intended to address this challenge and incentivize the upscaling of socially and environmentally sustainable initiatives such as CEs. Additionally, positive incentives could be rolled out for businesses that actively seek to minimize production output. This could, as mentioned above, take the form of tax reductions on proven durability or favorable interest rates for start-ups that present detailed plans to minimize production and waste output. This would help keep businesses profitable in the face of a reduction in production and sales output. Such positive incentives could be supplemented with repercussions, including additional taxation on less durable and polluting products, carbon offsets, or minimal sustainability requirements for products.

It has been observed that many CE initiatives do not have an eye for the concept's "social dimension" (Geissdoerfer et al. 2017: 766). Thus, when promoting CEs there is a need for a holistic approach that not only addresses recycling, but also resource reduction and human well-being – with human rights, prosperity, and poverty reduction as key elements in a sustainable and healthy economic system (see also: Murray, Skene, and Haynes 2017).

According to Jaeger and Upadhyay (2020), "the major barriers for implementation of CEs are: quality issues in recycled materials, supply chain complexities, coordination problems between companies, design and production of the product, disassembly of products, and high start-up/ investment costs." In a similar vein, Geissdoerfer et al. (2023) present a matrix of 25 barriers and 10 drivers for CE initiatives particularly related to start-ups wanting to partake in the CE wave. Both studies, represent valuable sources of inspiration, as global support and alignment of CE models is established. The establishment of CE models is highly context-dependent, and as noted by Henrysson and Nuur (2021), local institutions and their frame of operation make up a crucial component in the successful implementation of CEs. Thus, to ensure holistic and integrated CE models across scales and contexts, deep case-specific analysis is imperative to the formulation of any CE initiative.

Maturity

As mentioned, many national and international CE initiatives already exist. There has been an increased uptake of the concept among private corporations, which shows its effectiveness as a tool, amongst many, that can be mobilized toward sustainability. However, research on CEs points out the need for increased coordination to ensure that CEs initiatives eventually come to serve the same purpose and end result, and that the notion of CEs is not merely mobilized for purposes of "green washing" (Kramer 2012). Increased international coordination will help ensure that the concept not only encompasses principles of increased recyclability, but also principles of consumption reduction and human well-being. It must be highlighted that understanding circularity, in its holistic sense, entails harnessing the interconnectedness of the planet for the greater good. Consequently, international coordination may also entail internationally agreed upon regulations on what exactly constitutes CE initiatives. Lastly, to align and coordinate CE models across scales and geographies, we must also align public and private interests. This issue is also addressed in idea c of this entry point, which promotes a move beyond GDP as a measure of economic progress. By reconfiguring our conception of economic success, we may also promote a positive change in consumer and business cultures based on principles of social and environmental sustainability, which is at the center of holistic and integrated CE models.

Success criteria

- Broad incorporation of principles of reduction and human well-being within CE frameworks.
- Increased conservation of natural resources.
- Optimized utilization of natural resources.
- Increased corporate and governmental uptake of CE principles.
- Measurable decline in waste and pollution from industrial production.
- Increased public trust toward corporate entities and governments.
- Increased social and environmental responsibility taken by major corporate forces.

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b. International compensation for lost growth pathways amid green energy transition

Description

The group highlighted the need to create an international fund (or utilize existing aid mechanisms) to compensate developing economies for lost development opportunities, as the world transitions from fossil-based resources to green and renewable energy. One possible avenue of implementation could be an extension of the UN's Green Climate Fund (Green Climate Fund 2023). Many states in the Global South have been denied the development opportunities of Western and major Asian economies, which were built on carbon-based development efforts. Carbon-based development efforts are no longer an internationally accepted growth pathway. Accordingly, developing states must be compensated for lost opportunities resulting from a global transition toward CO_2 neutrality. Thus, the compensation fund is not only intended to compensate for lost development opportunities, but also to build a foundation for green energy self-sufficiency in developing countries.

Increased research on the exact opportunity losses is needed as a baseline measurement to determine the compensation share. Likewise, there may be moral and ethical considerations, which need to be discussed. These may include how to secure transparent and fair distribution of funds, and how to avoid problems of aid dependencies and inadvertently reproducing post-colonial exploitation. Finally, it needs to be determined who qualifies as beneficiaries of the fund, and which states act as contributors. This could be based on the UNDP's Global Multidimensional Poverty Index, which identifies different "deprivation bundles" used to rank the most impoverished nations on the planet (UNDP 2022).

The compensation should be earmarked for sustainable transition (appropriate for the given context) to ensure equal access to green energy and general development opportunities globally. This could also include initiatives toward energy conservation and efficiency, thus also addressing how to improve current energy production until a complete CO_2-neutral energy production becomes a realistic potential. The fund's revenue could be financed through CO_2 taxation, thus utilizing carbon-based revenue to fast-track a transition toward just global CO_2 neutrality. This will assist in addressing a persistent dilemma in development economics posed by "the three zeros", namely the dilemma between reaching zero-income poverty, zero-energy poverty, and (net-)zero emissions (Yunus and Weber 2017).

Increased access to green energy infrastructures will allow developing countries to partake in an industrialized reality. This is also emphasized in the Addis Ababa Action Agenda's call for "promoting inclusive and sustainable industrialization" (United Nations 2015). While compensation for lost development opportunities will assist developing countries in their efforts to reach net-zero emissions, there may not be sufficient funds to secure this target for all. Therefore, the fund should not be seen as a final solution to global inequalities pertaining to green transition, but rather as an effective tool, amongst many, to ensure a just and sustainable global transition.

Both national and international governance is a crucial lever for the successful implementation of the compensation fund. Detailed means of control, regulation, and enforcement must be put in place to ensure just and lawful management of the fund. Such modalities must be formulated and agreed upon by all participating parties prior to the fund's establishment. We recommend the use of independent evaluators and observers to monitor the progress and impact of the fund. Financing the compensation fund will be a major challenge as the initiative hinges on international agreement and collaboration.

One way of financing the fund could be to earmark national carbon taxes directly for the fund. Likewise, the international donor community has yet to fulfill its 0.7 % of the GNI foreign aid target in accordance with the ODA agreement (OECD 2023). Contributions to the compensation fund would help reach this target, and the fund could – on national levels – form part of existing aid mechanisms. To develop and design the fund, international and interdisciplinary scientific collaboration is needed to gauge various overlapping dimensions (e.g. economic, social, cultural, and political) related to its implementation. Lastly, implementing this idea requires vast public support. This will boost advocacy on governance and policy levels and ensure broad public endorsement.

Context and application

Ideally the fund becomes a global interstate collaboration. The direct beneficiaries of the compensation must be considered developing economies based on a scientific measure such as the UN's Human Development Index (HDI). It is crucial that the fund targets green energy transition directly in the beneficiary context through context-specific and democratically developed transition initiatives with broad public benefit and support. However, by targeting a reduction of CO_2 emissions and green energy transition, while addressing global energy poverty and inequality, the initiative is considered of broad planetary benefit.

Relevant actors

The compensation fund is intended to compensate developing economies for lost economic opportunities resulting from the exclusion of carbon-based resources from their growth repertoire. This is meant to support a global and just transition away from carbon-emitting resources, while recognizing the negative economic growth impacts this could have on developing economies. Some states with a high CO_2 footprint, and their constituents, may disapprove of this initiative. It therefore requires much advocacy and negotiation to reach its implementation. The idea is likewise dependent on members of the international donor community and their willingness to live up to the ODA agreement's target toward foreign aid. That said, if contextualized properly, it should be clear that combined reductions in poverty, inequality, and environmental pollution constitute a collective benefit to all.

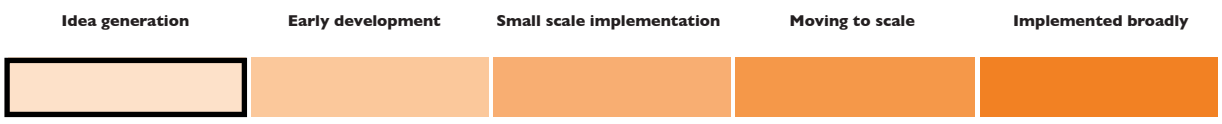
Implementation strategy

The fund could be administered within an existing international body, e.g. the World Bank or the United Nations (e.g. as an extension of the Green Climate Fund). Preferably, this implementing entity should work in conjunction with other relevant international bodies, such as the OECD, the Asian Development Bank, or the African Development Bank. Alternatively, the idea could be implemented on smaller national scales, where the fund could be administered by national development agencies, such as Danida in Denmark, USAID in the United States, or Japan's ODA. Likewise, the sovereignty of beneficiary states must always be secured, and it is important that both contributors and beneficiaries negotiate a common fund framework and the conditions for all parties involved.

Challenges and barriers

Clear parameters for who finances and funds the initiative must be determined with due consideration to various socio-economic parameters. As mentioned, the UNDP's Global Multidimensional Poverty Index could be a starting point for identifying potential beneficiaries. It will be challenging to convince developed states to finance the fund (e.g. through earmarked CO_2 taxation). However, as the target of spending 0.7 % of the GNI on development is still unmet, contributions to the fund would be a step toward fulfilling this target.

Maturity



The idea is currently at the stage of idea generation. Much research is needed to develop a tool to determine which countries would be eligible for compensation. It is likewise dependent on broad-based uptake and support from contributor countries. As mentioned, although the fund should ideally be implemented on a global scale, it could be initiated on a national basis through existing national aid instruments. This latter model may serve as an ideal starting point to draw experiences from, as the fund is rolled out globally. On this note, it is worth noting that the UN's Green Climate Fund already aims to support developing nations in their efforts toward achieving sustainable climate transition (Green Climate Fund 2023). As mentioned, our idea could be implemented as an extension of this fund.

Success criteria

- Measured increase in renewable energy transitions in the developing world.
- Decline in global inequality.
- Decreased levels of global energy poverty.
- Fullfilment of the ODA agreement.

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c. Moving beyond GDP: Creating new additional measurements of socio-economic progress and growth

Description

This idea targets the issue of solely measuring growth through GDP. Instead, we urge for pluralistic and context-specific measures of growth in addition to production output. These should embrace both human well-being and sustainable consumption within planetary boundaries and with respect for the beyond-human environment. The idea springs from intensifying academic debates on "degrowth" that argue for "a new social order freed from the goal, today still hegemonic, of unlimited economic growth" (Romano 2020: 30). New plural measurements of growth and progress need to factor in parameters of human and environmental well-being, in addition to monetary and material growth and increases in production. Currently, a clear international consensus on what defines human well-being does not exist. However, attempts have been made to estimate development based on pluralistic measures, e.g. the UN's Human Development Index (HDI). Other promising models for estimating a minimum threshold for human well-being have been provided by several scholars (see e.g.: Millward-Hopkins et al. 2020, McGillivray and Clarke 2006, Rao and Min 2018, Vander Weele et al. 2020, Allin and Hand 2017).

Our proposal queries the relevance of economic growth (in its current formulation) which does not factor in the potential human suffering that, at times, results from increased material production and extraction. A hypothetical example is how the relocation of indigenous peoples from their ancestral land to make way for the exploration of natural resources could be measured as a step toward economic growth, while exacerbating inequality and lessening human and environmental well-being in this given locality. There is a need for in-depth research and negotiation on the exact indicators that should be included in a pluralistic measure of socio-economic growth and prosperity. This should begin with a collective evaluation of existing initiatives aimed at moving beyond GDP as a measure of socio-economic progress. The publications listed above point to different solutions, and we recommend establishing collaborations between social scientists and policymakers as well as dialogue with the general public when it comes to determining indicators of human well-being to be applied in policy-making and governance. Around the world, international, national, and local efforts have already been made to expand the parameters measuring growth and progress.

Some examples include the UN-backed System of Environmental Economic Accounting (SEEA) framework, which aims at assessing the environment's relation to the economy (UN 2023), and the UNEP initiative on Inclusive Wealth (UNEP 2018). Multiple local governments, including the municipalities of Copenhagen in Denmark and Amsterdam in the Netherlands, have adopted the "Doughnut Economy" (Raworth 2017) model aimed at broadening the measurement of growth and progress beyond GDP (see section: Maturity status). However, global implementation requires significant backing, commitment, and collaboration from international bodies such as the UN, the World Bank, and the International Monetary Fund, as well as private actors on the global market. Examples of state efforts to transcend GDP are multiple and include the United Arab Emirates' National Programme for Happiness and Wellbeing and Bhutan's Gross National Happiness (GNH) Index. Other countries such as Scotland, New Zealand, and Iceland have opted for becoming "well-being economies", which entails putting human well-being at the center of economic decision-making processes (Scottish Government 2019, Wellbeing Economy Aliance). These examples show global interest in adjusting our perception of economic success, growth, and development. It also shows how inspiration can be drawn from a bouquet of global cases and experiments.

We see these local and national initiatives as promising. However, in acknowledgment of the global nature of our economy, this momentum must be harnessed to mainstream a pluralistic and holistic understanding of growth on an international scale. Thus, required actions include the establishment of policy tools to translate new measures of progress into just and sustainable improvements to lives across the planet. It is important to stress that this idea seeks to move beyond linear rankings (such as GDP). Instead, we promote showcasing the complex systems and tradeoffs that characterize decision-making and policymaking. Wide public support for this initiative is required. It is particularly important to convince large financial players who benefit from our current growth paradigm. It is equally crucial that both the public and academics are consulted when it comes to deciding which parameters should form the basis of new and improved growth measures. Accordingly, the global public must be encouraged and allowed to partake in economic policymaking and decision-making processes. (See also Idea d., "Peoples' economic summit", of this entry point).

Context and application

This is a universally applicable idea, which currently is partially implemented on small-scale national and local levels. Equally, while the idea is universally applicable, it must be adapted to the given context and scale in which it is implemented. Measures of growth and prosperity are context-specific and must be aligned with the context in which the measures are used (see also: Vander Weele et al. 2020). It would be ideal to develop an international measure

of growth that makes grand comparisons possible while remaining open to additional national and regional growth parameters. This will also allow for both bottom-up and top-down initiatives to be rolled out simultaneously and eventually inform and synergize one another.

Relevant actors

As mentioned earlier, there are several actors to consider when contemplating this proposition. First, there are national and international institutions of governance and policymaking, which need to adopt new growth parameters equal to GDP. Similarly, such adjustments need to translate into direct behavioral change among both companies and citizens globally. By highlighting the interconnected and interdependent factors that lead to human and environmental well-being, we believe that people will be able to make better reflected decisions concerning consumption. In the same vein, governments will be better equipped to gauge their strengths and shortcomings holistically, while companies will be prompted to prioritize a greater sense of human and environmental consideration when conducting their business.

We consider it imperative to formulate these new measurements of growth in collaboration with a broad range of public interest groups (e.g. marginalized communities, trade unions, spiritual and religious communities etc.) to ensure broad public representation and support. This approach would require multi-modal collaborative research and development initiatives aimed to gauge public concerns, which must form the basis of a new growth paradigm.

Implementation strategy

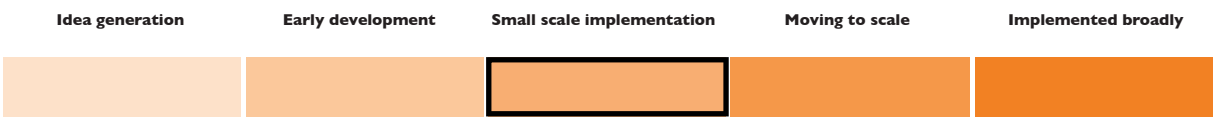
The idea has already been rolled out (at least partially) in certain localized settings. However, a broader international transition is imperative to reach the idea's full potential. This could be initiated by international bodies such as the UN, World Bank, European Union, African Union, or BRICS coalition, who could adopt a formal emphasis on psycho-social and environmental considerations in the measurement of economic growth and development. As shall be elaborated below, the EU and UN have already expressed motivation toward this initiative. Similarly, businesses must be encouraged to adopt psycho-social and environmental factors in their conduct. With a pluralistic measure of progress, we have the chance to both incentivize businesses to factor in human and environmental prosperity and, if required, regulate those businesses that cause the greatest social and environmental destruction. Ideally, we envision that bottom-up and top-down initiatives synergize and inform one another through principles of best practice. We therefore encourage broad collaboration across different spheres and levels of engagement. Furthermore, we deem in-depth analysis of initiatives across scales, with an aim to harness best practice, crucial to mainstreaming a pluralistic measurement of growth.

Challenges and barriers

One major obstacle is convincing states, institutions, and businesses to adjust their current measurement of economic growth beyond production output. This may be difficult in regards to e.g. states that have a relatively high GDP and high levels of socio-economic inequality and/or environmental pollution. In such cases, GDP may serve as a more lucrative measure of growth.

Another key obstacle is agreeing on what specific parameters will supplement GDP as a measurement of growth. This is why we suggest context-specific growth parameters designed with consideration to their socio-economic, political, geographical, and environmental context and scale. To supplement these localized growth parameters, an international parameter could be developed to make global comparisons available. For example, to inform initiatives such as the international compensation fund presented within this entry point. One tangible way of achieving this international measure could be to incorporate the mentioned "Doughnut Economy" (Raworth 2017) model into the current formulation of the UN's HDI.

Maturity



The UN secretary-general's "Our Common Agenda" report (UN 2021) promotes creating new growth measures to supplement GDP. Likewise, the EU has for more than a decade proclaimed efforts to promote pluralistic measurements of progress (European Commission 2023). However, the primary indicator of growth and progress remains GDP, despite its often negative social and environmental trails. The state of Bhutan has experimented with the implementation of a GNH Index. The UN has applauded this initiative, which remains to be implemented on a broader international arena, though. Smaller local initiatives across major European cities, including Amsterdam and Copenhagen, have committed to implementing the "Doughnut Economy" model. Such small-scale initiatives indicate a widening support for conceptualizing economic growth through new parameters that factor in human well-being and environmental sustainability. The "Doughnut Economy" model includes an "environmental ceiling", which delimits a safe operational space where the planet's capacity of the planet to provide life-support systems for humanity is not endangered. The framework aims to assess the performance of an economy by the extent to which the multiple needs of people are met

without overshooting Earth's ecological ceiling (Raworth 2017). This could be a direct source of inspiration in connection with the proposed development of new international indicators.

Overall, we are still far from seeing a global uptake of pluralistic measures of growth, and GDP remains the dominating indicator of growth and prosperity. However, the initiatives and interest highlighted above reveal large-scale governmental interest in experimenting with such initiatives. Therefore, we urge large, interstate entities like the EU and UN to make efforts toward developing, promoting, and implementing the pluralistic measures they themselves have called for. This also entails promoting the uptake hereof and negotiating their contents with scholars and actors from various interest groups across spheres, geographies, and socio-economic standings.

Success criteria

- Increased uptake of alternative growth parameters across scales and localities.
- A measurable correlation between changed growth parameters and increased experiences of human and environmental well-being.

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d. People's economic summit

Description

To initiate a process of rethinking a capital-centered economic system, we suggest an inclusive platform for economic discussion and negotiation. Numerous initiatives across the globe have sought to create a global democratic dialogue. However, such initiatives have one main drawback, namely that they rarely foster binding agreements and commitments. This idea seeks to break with this trend and promote an effort that builds on existing experiences in creating global democratic dialogue, though with a specific emphasis on fostering commitment and binding agreements across different socio-economic and geographic scales. This draws on principles from experiments with "participatory budgeting" – a public participation model that allocates a specific portion of a public budget for citizen-selected projects (Wampler, McNulty, and Touchton 2021). However, whereas these initiatives are localized and scattered, this idea is intended to bring these principles of direct democratic participation into an internationally coordinated framework. This will provide an alternative to economic congresses for government and business elites, such as the World Economic Forum, by gathering groups currently excluded from economic decision-making processes and giving them direct decision-making influence. Facilitating participation and decision-making among people who are not at the top of the global economic system is crucial if we are to create a democratic, just, and sustainable future. This includes those who are currently excluded from political decision-making or inhabit marginalized positions when it comes to large-scale business interests, such as rural and indigenous communities, activists, artists, critical researchers, workers, ethnic minorities, small-scale cooperatives etc.

The idea can be initiated in a localized model where people meet in smaller groups within existing community structures (e.g. cooperatives, social solidarity economies, local councils, or other interest groups) and discuss and agree upon economic priorities from the perspectives of their everyday lives, local cultures, and value systems. Such processes can at best leverage individual and collective actions toward moving economic and financial decision-making powers to the grassroots (De Vries, Nemec, and Špaček 2022). After the local summits, these self-organized groups send representatives to a national summit, where the representatives negotiate and come up with a set of national goals, which they subsequently present to their constituencies. The participants at the national summit democratically elect a group of delegates who shall participate in the final international summit – the people's economic summit. All participating countries nominate delegates for the final summit via a similar process. Between the national and international summits, the delegates will engage in direct negotiation with their national governments on the resolutions made.

A similar process must be followed at the international people's economic summit. The international summit is not a symbolic platform, but a forum for actual negotiation among the elected parties, who represent the interests of their constituents. The difference between this process and other summits is that the participating individuals do not represent established political or business interests. Instead, they possess the power to bring decisions and discussions back to their constituents, where they are put into effect at national and local levels.

Commitment from national and international bodies of governance to agreements reached during these conferences is imperative. Ideally, these bodies of governance will be present at all levels of the initiative and will be held accountable for concrete and tangible agreements made following the final summit. However, considering how difficult it can be to enforce such commitments (this is evident from the lack of impact of existing initiatives, a second tier of the summit is envisaged. Here the interest groups negotiate agreements and subsequently present the consensus to their respective communities. We believe this will ensure that any challenges are addressed across local, national, and international scales. We recommend that the idea be adopted by states that have already committed to becoming "well-being economy governments". These currently comprise Scotland, New Zealand, Finland, Iceland, Wales, and Canada (Wellbeing Economy Aliance). Given these states' explicit commitment to creating well-being economies, we deem them ideal frontrunners in creating platforms for direct economic democracy.

Context and application

The idea starts with small, local summits, which lead to national summits, and finally an international people's economic summit. There need not be clear stratification along political boundaries, as some community structures may transcend such boundaries. The idea should be scaled to the appropriate level of representation, where the process can be tested and experience can be drawn. Constant monitoring of the initiative is required, as this will make it possible to flexibly adjust its modalities and ensure an adequate degree of inclusion and participation. It is up to the institution responsible for the implementation to appoint a body to monitor the process. Likewise, it is important to have skilled facilitators and support mechanisms in place to avoid exploitation and misunderstandings concerning both negotiation and agreements. This also includes providing legal assistance and protection to the participants – especially those navigating marginalized and exposed positions.

Relevant actors

Existing platforms for public mobilization, such as cooperatives, trade unions, local councils,

pressure groups, and bodies representing the governance structures of indigenous and other ethno-cultural groups, will be key in securing broad public representation. Likewise, less formalized, organic political platforms must be explored for additional representation beyond formalized organizations and institutions (see e.g.: Larsen 2022, Masquelier 2013). As mentioned above, it is crucial that the initiative has strong institutional support and endorsement from all actors involved in the process, including local, national, and international bodies of governance.

Implementation strategy

We realize that a process that begins with localized spaces and ends with an international platform requires gradual implementation. We therefore urge national and even local governments to engage in open economic dialogue and negotiation with their constituents based on the principles outlined in this idea. It is imperative for local and national governments to commit to a negotiation process where committed agreements are made on the basis of democratic dialogue with a broad and inclusive representation of society.

We consider the United Nations Development Programme (UNDP) an ideal entity for implementing the idea on an international scale. The proposed summit is a parallel to the Conference of the Parties (COP) held to address climate change, biodiversity, and wildlife trade, as both governmental and non-governmental actors are represented. However, it is different from the COP process in that the decision-making power does not rest solely with governments, but largely with participants, as is the case with the World Economic Forum. Likewise, while the people's economic summit must address issues of climate change mitigation, environmental management, and general sustainability, these issues must be discussed in tandem with socio-cultural and other political concerns of the participants.

To achieve successful implementation of this idea, it is also necessary to ensure democratic and economic understanding amongst all groups participating in the summit. This requires simultaneous scientific research and evaluation to ensure successful results throughout the process. Moreover, it requires public economic education, e.g. through a mixed media approach.

At inception, a series of small group meetings at local levels will be held to identify the key stakeholders and structures for organizing people. Once these actors have been identified, regional or sub-regional meetings will be organized to present the agenda for the coming year. A national-level forum will be held once every two years to pool together the required decisions and actions for direct discussion. Finally, this is envisaged to lead to the international summit once every four years, where trans-boundary discussions and agreements can be made.

All agreements must have a definite implementation plan. All signatories must commit to the implementation of the agreement and implementation plan, which should be made public with full transparency following the summits. To make the initiative more operationally realistic, it may be relevant to investigate to which extent online and digital platforms could be utilized, either during or in-between summits. However, utilizing digital platforms also introduces a set of challenges, including unequal online access around the world, and as observed by Cohen and Fung (2023), the use of digital platforms for democratic engagement also rests upon a strengthened sense of democratic responsibility amongst all participating parties.

Challenges and barriers

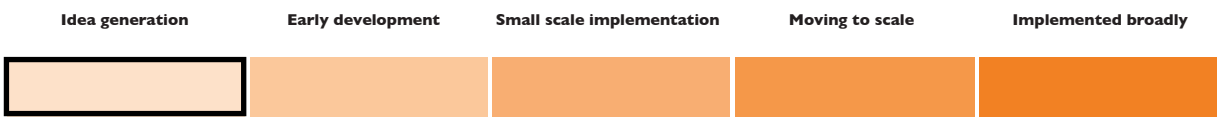
This idea faces at least four challenges. The first challenge is concerned with finance and organization of the summit. Given the ambitious scale of the idea, it will require major investments and logistical management. However, we consider the idea equally compatible with small-scale implementation on national and local levels, which would require fewer financial resources and provide a basis for demonstrating the concept's applicability in practice.

The second challenge is to cultivate commitment and buy-in, which binds all participating parties to the agreements made during the summit by virtue of international law, agreements, protocols, and conventions. It is important to have sensitive, well-trained facilitators at the summit who can ensure equitable and just representation and conduct amongst all participating parties. It will be the responsibility of these facilitators to make sure that dominant voices do not drown the less dominant ones. Given the goal of direct public decision-making, some institutions of governance may be reluctant to implement the idea. However, with institutions such as the EU and World Bank promoting participatory budgeting as part of their international support programs, there seems to be increased willingness to engage in direct public dialogue – at least to a certain extent (Wampler, McNulty, and Touchton 2021, Vries, Nemec, and Špaček 2022).

The third challenge is to ensure broad and well-informed public participation and thus adequate representation, especially of constituents who may feel excluded from conventional platforms of dialogue. Some react with mistrust or skepticism to any new process, and existing tensions or disagreements may hinder dialogue. Thus, successful participation rests upon the utilization of both formal and informal channels of mobilization and extensive educational and informative efforts with potential to create broad-based democratic awareness and trust in the process amongst the participants. It is important to be mindful of the multilayered inequalities that will surface during these negotiations (even among e.g. different marginalized groups). Clear measures for mitigating such inequalities need to be developed, e.g. by providing additional (legal, financial, and negotiation) support to the most marginalized and vulnerable participants.

A final challenge is to develop tools to resolve potential tensions when negotiations reach a standstill and the negotiating parties are unable to reach an agreement.

Maturity



This idea draws on several experiences of international political dialogue and negotiation. Initiatives that inspired this idea include the international efforts of bridge-building and direct political negotiation as practiced by organizations such as the World Social Forum, Shack Dwellers Internationals, and Southern African People's Solidarity Network. The latter annually facilitates the SADC people's summit in response to the SADC heads of state summit. However, these summits happen without commitment from, and direct negotiation with, decision-makers.

A larger international example to draw on are the international COP meetings, which include an array of civil society representatives. Such initiatives show the potential of broadened public participation in political decision-making. For this idea to lead to actual change there must be political commitment, participation, and buy-in. This also points to the main weakness of the idea, namely its reliance upon a political apparatus that cares for issues of direct democratic inclusion and broad-based human and environmental well-being. Considering the challenges of existing initiatives with regard to securing political commitment, we are conscious of this major limitation.

As highlighted in idea c in this entry point, "Moving beyond GDP", multiple governments around the world strive to become well-being economies. To bolster these initiatives, we deem these governments the perfect frontrunners; they can initiate a people's economic summit within their constituencies and as part of their collective toolbox for becoming well-being economies. An international people's summit could be realized by bringing together these different initiatives toward broadened democratic inclusion. It is important to note that our aim here is not to substitute or override formal national and international democratic systems. Rather, the idea is meant as a supplementary tool, which can strengthen both democratic mass awareness and overall experiences of inclusion in global decision-making.

Success criteria

- Experienced increase in democratic representation and economic influence among citizens of participating countries.
- Sustainable and just adjustments to the global economic system as a result of the summit.
- Broadened democratic awareness among the global public.
- Number of priority areas identified, agreements reached, plans formulated, and actions taken. These outputs and outcomes could be tracked at all levels (local, national, and international).

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By Gemma Evans via Unsplash

e. Regulation on sustainability reporting for corporations based on absolute environmental indicators

Description

Inspired by the new EU "Corporate Sustainability Reporting Directive (CSRD)" (European Commission 2023), we propose global regulation on sustainability reporting for multinational corporations based on absolute environmental indicators. The CSRD obligates companies in the EU to report on environmental and social issues. This does not mean that companies can have no negative social and environmental impact. Rather, the reporting is intended to help investors, civil society, and consumers to evaluate the performance of companies, and in this way, create incentives for the companies to improve their sustainability performance. Such regulation on sustainability reporting could be a "soft" supplement to direct regulations on companies' actions. Reporting must include "absolute" representation and measurements of sustainability. Today, when environmental impacts (e.g. climate change, biodiveristy, or resource depletion) are measured, companies tend to adopt a "relative" approach. For example, a company may report its CO_2 emissions in order to compare them with those of other companies or the company's past emission records. This relative indicator may show that the company's environmental performance is better than before or better than that of other companies (i.e. relative sustainability). However, it does not show whether the company's impacts are low enough to curb our environmental predicament, or if measures to decrease future impacts are adequate to meet the environmental challenges facing our planet (i.e. absolute sustainability). For this, we need to think in more "absolute" terms and look at whether the environmental budget is exceeded or not. The environmental budget can be defined according to Planetary Boundaries (Rockström et al. 2009, Steffen et al. 2015) or other environmental boundaries delimiting the safe operating space where the capacity of the planet Earth to provide life-support systems for humanity is not at risk (see Vea et al. 2020 for an overview of environmental boundaries).

A crucial aspect of absolute environmental sustainability assessments is allocating a share of the safe operating space to the anthropogenic system subject to assessment (e.g. nation, sector, or product). In the case of absolute sustainability reporting for companies, the safe operating space must be allocated to specific activities to address whether the company respects the environmental constraints. There are several principles for allocating a share of the safe operating space (also called sharing principles), which has a normative and ethical nature (see e.g. Ryberg et al. 2020 for an overview and recommendations on best practices for defining sharing principles).

Regulation should include requirements and concrete guidelines on how to quantitatively measure absolute sustainability indicators, including setting environmental boundaries and sharing the safe operating space. This could be based on the Science Based Targets initiative, which offers an industry-driven standard for measuring climate change performance and nature loss (Science Based Targets Initiative 2023). Global regulation on sustainability reporting for large corporations based on absolute environmental indicators will make it transparent to the public whether or not companies are on the right track to sustainable performance (i.e. respecting the environmental "budgets") and, if not, put pressure on companies to do so. It is therefore important that these indicators are easy to understand and visible to the public, including e.g. investors, policymakers, general consumers, and NGOs.

Context and application

Regulation on sustainability reporting should target both large, multinational corporations and small and medium-sized enterprises (SMEs) of a certain size (e.g. more than 500 employees) and not be limited to companies located in the EU (i.e. have a global scope). However, in acknowledgment of the challenges of creating global standards and regulations, we suggest the EU (given its existing CSRD regulative) as fertile ground for initiating this proposal, with an aim to upscale the initative to a global scale. The regulation should oblige companies to undertake reporting. Finally, the regulation should include requirements and concrete guidelines on how to quantitatively measure absolute sustainability indicators. As mentioned, this could be based on the indicators formulated by the Science Based Targets initiative.

Relevant actors

Although, the proposed regulation targets mid-sized and large companies, it also involves investors, who may use it to access the information needed to assess investment risks concerning sustainability issues. While consumers are not the direct target group of the initiative, transparent reporting on absolute sustainability will enable informed consumer choices. NGOs and civil societies will be equipped to put pressure on companies to respect the environmental budgets. Investors will be able to direct their investments toward corporate activities that consider the health and well-being of our planet. Finally, a primary beneficiary, at large, is our planet, which is in dire need of humans to shift their general engagements with the environment toward symbiosis rather than exploitation. Considering our consumer-driven global economy, it is crucial to make consumption-driven pollution transparent to the greater public so that they can make informed decisions.

Implementation strategy

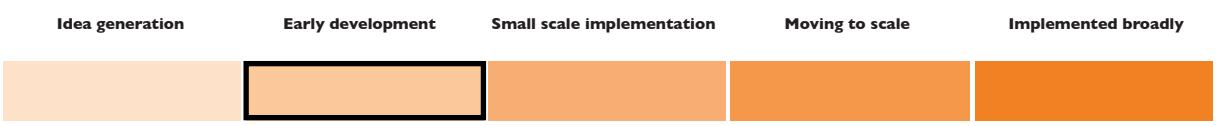
Although the idea should ideally be implemented globally, such global regulatory collaboration is unprecedented. Thus, the regulation may have to be implemented on national or confederal levels (such as the EU) first. As mentioned, similar regulation has already been implemented in the EU in the form of the CSRD. However, the CSRD is limited to the EU and does not include concrete guidelines on how to quantify absolute environmental indicators. Thus, an ideal starting point would be to include in the CSRD set and transparent guidelines for companies on quantifying absolute environmental indicators and an obligation to disseminate these to the consumer. We hope that the success of such an adjustment will inspire a broader global call for absolute sustainability accounting.

Likewise, when considering global implementation of mandatory sustainability reporting, it is crucial to acknowledge the significant financial resources needed to effectively uphold and evaluate such regulation. For low-income states (who often host the extraction and manufacturing ends of global supply chains), this may pose a problem. It is thus imperative for high- and middle-income states to support (both financially and through know-how) low-income states in upholding and monitoring said regulation. This also entails international alignment of the environmental indicators measured.

Challenges and barriers

A primary challenge of this idea is its global scope (as addressed in the above section). Likewise, while robust methods for measuring absolute sustainability indicators exist, there are several methodological challenges, including the question of how to handle the regional character of many environmental impacts and the accompanying geographical variability of the boundaries and operating spaces, and the question of how to share the safe operating space with different entities (e.g. other corporations, states, local authorities, communities etc.).

Maturity



Along with the CSRD, the EU is elaborating CSR reporting requirements in the "European Sustainability Reporting Standards" (ESRS) (European Financial Reporting Advisory Group 2021). The ESRS mentions the planetary boundaries and that "[t]he undertaking shall disclose its plan to ensure that its business model and strategy are compatible with the respect of planetary boundaries of the biosphere integrity" (European Financial Reporting Advisory Group 2022). However, standards on how to measure this are not provided in the draft version. There exist initiatives such as the Science Based Targets, where companies report on their performance in relation to the Paris Agreement targets (or budgets) (Bjørn et al. 2022). Although this is on a voluntary basis, a lot of companies from all over the world have joined the initiative. This could serve as inspiration for a global regulation on sustainability reporting and demonstrates the willingness of private entities to partake in environmental budgeting and reporting. Moreover, the scientific community has developed methods for quantifying absolute environmental sustainaiblity indicators (e.g. Bjørn et al. 2015, 2020, Ryberg et al. 2018), which could serve as a basis for developing guidelines for the global regulation on sustainability reporting for corporations based on absolute environmental indicators.

Success criteria

- Increased transparency on sustainability.
- Increased demand for sustainably produced products.
- Increased consumer trust.
- Increased sustainability initiatives from large-scale corporations.

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ENTRY POINT 3

Sustainable food systems and healthy nutrition

Across the globe, there is a growing consensus that radical transformations in how we feed the world are urgently needed in order to halt rapid loss of biodiversity, land degradation, deforestation, climate change, and hunger. There are, however, competing visions for how such transformations can occur (Pimbert 2023). Spread across three co-creation sessions, our transdisciplinary working group identified key challenges facing sustainable food system transformation and elaborated upon five concrete ideas for translating research into societal action. The working group was comprised of researchers across disciplines and lived experience experts outside of academia. This included doctoral researchers, postdoctoral researchers, government representatives and leading science experts. Given the diverse backgrounds of our participants, this idea catalogue includes ideas stemming from different, and occasionally competing, visions of development. We encourage readers to consider what type of change is most appropriate for real-life application in a specific context – whether it be a change that is incremental in nature (i.e., improving the use efficiency of harmful inputs, such as synthetic fertilizers or pesticides) or one that is transformative in nature (i.e., redesigning agroecosystems, based on the principles of sustainability and equity for all human and non-human nature).

The five ideas proposed in this section stress the role of governance in sustainable food system transformation. These ideas offer governance frameworks that facilitate the use of different sustainable and equitable practices across ever widening territories, while also acknowledging the context and place-dependent nature of individual solutions. Specifically, our working group discussed the potential of boundary partnerships – situated at the interface of knowledge and action – to assign responsibility to actors, improve implementation of transformative initiatives, and align research agendas with regional decision-making timelines. We outlined opportunities to transform Global North agricultural financing to support multifunctional food systems that operate within planetary boundaries and under just social circumstances, as well as the potential of remote sensing technologies to support direct subsidy payments to Global South farmers. Lastly, we discussed the potential of local biowaste-based circular economies to support the decarbonization of the economy while developing symbiotic relationships between producers and consumers. Several additional themes emerged during our discussions, which we were not able to elaborate further upon and present in the catalog due to the expertise of the working group participants. These included people-centered approaches, risk management, Living Labs to create collective action, dietary and cultural shifts, novel and future foods, regulatory constraints, and technology lock-ins.

Group Facilitators

Megan Resler
PhD, University of Helsinki. Agroecologist with a specific interest in the social and political dimensions of sustainable food system transformation. As part of the Transformation Labs team, Resler co-facilitated the Sustainable Food Systems and Healthy Nutrition discussion sessions.

Nina Toudal Jessen
MPhil, PhD, University of Copenhagen. She is a historian of science and the environment with expertise in land use changes and planning policies. Her current research centers on historical drainage and contemporary rewetting of agricultural land in Northern Europe.

Participants

Bruce Campbell
Dr. Bruce M. Campbell is interested in outcome-oriented research in the area of food system transformation and climate change adaptation and mitigation for agriculture and food.

Benedict Smith
PhD candidate with specific interest in green chemistry and sustainable industrial technologies, studying materials for energy generation and smart sensing of agricultural fertilizers.

Lavinia Perumal
Ecologist and design-thinking coach based in Cape Town interested in integrating approaches such as design thinking and systems thinking.

Maria Figueroa
Associate Professor in climate mitigation, just energy transitions, and sustainability management at Copenhagen Business School.

Derrick Locha Mayiku
Master's student in Computer Science at JAIN University. Integrating technology with agriculture, focusing on sustainable, efficient farming practices.

Neil Burgess
Professor of conservation science at the Center for Macroecology, Evolution and Climate, GLOBE Institute, University of Copenhagen.

Bo Holm Jacobsen
Associate Professor Emeritus at the Department of Geoscience, Aarhus University.

Dave Chadwick
Researcher with an interest in optimizing nutrient management from organic resources and fertilizers and reducing diffuse pollution to water and air.

Marianne Thomsen
Professor in sustainability assessment and sustainable food processing and production with a PhD in environmental risk assessment.

Muhammad Saidam
PhD in environmental and water engineering from Imperial College London and a member of the UN Independent Group of Scientists and Experts, who prepared the 2019 GSDR.

a. Large national funds for regional food system initiatives using a community-led local development approach

Description

This working group proposes the creation of large, national-level funding mechanisms to finance small, regional-level food system initiatives aimed at agroecological transformation. Currently, the vast majority of government support to agriculture (e.g. agricultural subsidies and development aid) funds specialized industrial agriculture (Anderson et al. 2021). Such support directly perpetuates the use of unsustainable and inequitable practices (FAO, UNDP, and UNEP 2021). This has created a significant global opportunity to repurpose agricultural financing toward more sustainable, regenerative, and agroecological approaches (FAO, UNDP, and UNEP 2021). Emerging research calls attention to the potential of large, national-level funding mechanisms to divest support from specialized industrial agriculture and instead channel funds to small-scale, regional food system initiatives aimed at agroecological transformation (Schmutz et al. 2022). The process of distributing such funds can be supported by the community-led local development (CLLD) approach – formerly known as the LEADER approach – which is a method of mobilizing and dispensing rural development to local communities, first piloted in the EU in 1991 (European Commission 2006). The approach is based on seven key features, including (1) area-based local development strategies, (2) bottom-up elaboration and implementation of strategies, (3) local public-private partnerships, (4) integrated and multisectoral actors, (5) innovation, (6) cooperation, and (7) networking (European Commission 2006). Overall, the method relies upon – and aims to develop – the capacities, skills, and perspectives of local people (Konečný 2019).

Divesting agricultural support from industrial agriculture in this manner will engage all four levers. National governments must actively prioritize repurposing agricultural financing toward sustainable approaches; globally agreed food system targets negotiated at the Rio Conventions may provide political leverage in this process. Science and research partners should play a role in monitoring and evaluating how national-level funding mechanisms are organized as well as the outcomes of individual initiatives. Lastly, individual and collective action from civil society, land workers' unions, social movements, and community organizations stand to play a critical role in shaping the parameters of regional initiatives. While engagement of civil society in this way may create additional messiness and slow down decision-making, the processes can be guided with the structural support of the CLLD approach.

Context and application

While the principle of large national funds dispensed for small-scale regional food systems initiatives is applicable for all nation states, the socio-cultural context and biogeophysical reality of each territory will play a critical role in shaping the regional initiatives. International trade regulations (such as EU regulations) and local policy blocks will, furthermore, constrain, enable, and/or shape what types of initiatives this funding mechanism can finance and where.

Relevant actors

Several human actors with varied interests are relevant to this type of initiative. This includes international funders (e.g. the Global Environment Facility, the World Bank, and the Green Climate Fund), private donors and philanthropic foundations (e.g. IKEA and the McKnight Foundation), governments and nation states, landowners, land workers, farming communities, research institutes, professional associations and unions representing landowners and land workers, community organizations, and civil society. Non-human actors – including all species and ecosystems – stand to benefit from each initiative that divests from the specialized industrial agricultural model and channels funding toward agroecological and regenerative approaches.

Implementation strategy

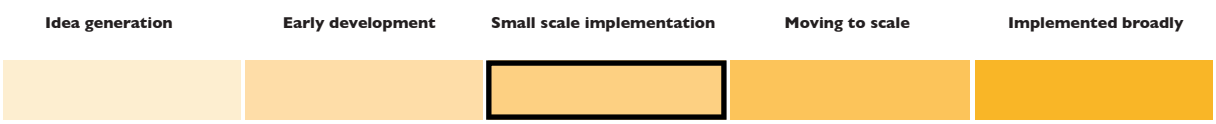
Nation states who are parties to the Rio Conventions (e.g. the UN Convention on Biological Diversity, UN Framework Convention on Climate Change, and UN Convention to Combat Desertification) can draw on globally negotiated and agreed food systems targets as political leverage for supporting large, national-level funding mechanisms. Once large national funding mechanisms have been established, funds can be dispersed to individual small-scale initiatives using the CLLD approach. This process should be supported by simple application criteria, the presence of a boundary partner to assist with any administrative burden among applicants, and educational training for grantees before funds are dispersed (Schmutz et al. 2022).

Challenges and barriers

Key challenges impede the implementation of this type of funding mechanism at two levels: first, the development of large funds at the national level, and second, how (and to whom) funds are dispersed at the regional level. At the national level, (1) policy and regulation blocks, (2) contrasting timelines between actors, and (3) piecemeal data on development aid and what money is going where all work to shape the size and modality of funds offered. At the regional level, (1) administratively burdensome application procedures, (2) costly advisory services,

and (3) too little support for transitions all pose challenges to the implementation of small-scale initiatives. For additional discussion on specific challenges associated with the implementation of the CLLD approach across the EU since it was launched in 1991, see Konečný (2019).

Maturity



Success criteria

Funding mechanisms for small-scale initiatives should be: (1) flexible, (2) territorial, (3) holistic, (4) associated with a low administrative burden for applicants, and (5) privilege local knowledge (Schmutz et al. 2022). Furthermore, experiences from past climate-service projects show challenges with sustaining change after the projects have ended (Steynor et al. 2016). As such, long-term thinking should be embedded within funding mechanisms to maintain partner relationships and evidence the success of agroecological approaches over time (Schmutz et al. 2022).

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b. Circular bioeconomies for reducing food waste, nutrient loss, and energy consumption in food production

Description

This working group proposes a shift toward local circular bioeconomies in which food production, food processing, and energy production are integrated to significantly decrease the need for external inputs, while also closing nutrient and energy cycles. Globally, population trends move toward increasing urbanization, which requires large amounts of energy and increases distances within food supply systems. By shifting toward local circular bioeconomies, energy loss can be avoided and thus support the development toward a higher degree of self-sufficiency in urban and peri-urban areas (Venkata Mohan et al. 2020). Thus, the idea combines the research fields of circular economy and food systems science to shape food production in a way that reduces energy costs and the need for external inputs, while closing nutrient cycles. The transition toward local biowaste-based circular economies can transform existing biowaste management facilities into innovative cascading biorefineries with multiple high-value products (Angouria-Tsorochidou, Teigiserova, and Thomsen 2022). Established examples include the EU project Decisive, which created local bioeconomies in three European cities – Lyon (France), Barcelona (Spain), and Dolina (Italy) (Decisive N.d.). The project test sites worked closely together with local canteens, farmers, and municipal waste management facilities to promote and ensure efficient organic waste collection for reuse as biofertilizers or local biogas plants. Thus, urban biowaste was used in food waste-based fertilizers on peri-urban farms, thereby shortening food supply chains.

In a similar model piloted in Finland – Agroecological Symbiosis (AES) – emphasis was on creating a circular economy-based food community powered largely by the symbiotic system's own bioenergy (Helenius, Hagolani-Albov, and Koppelmäki 2020). In the AES model, biomass from nearby food producers (e.g. cereal and vegetable farms) provided the digestate for a local biorefinery producing renewable energy used to power food processing infrastructure (e.g. grain drier and bakery) while also circulating nutrients back to the farms in the form of organic fertilizer (Helenius, Hagolani-Albov, and Koppelmäki 2020). Excess bioenergy can be sold to nearby energy clients, though the goal is for production to remain limited to what can be sustainably regenerated within the specific agroecosystem (Helenius, Hagolani-Albov, and Koppelmäki 2020). In both cases, shortened food supply chains support resilient communities at local and regional levels by promoting local, small-scale industry. Circular system designs inte-

grate food production, processing, and consumption, as well as energy production in a way that significantly reduces the need for external, fossil fuel-based inputs. Together, these factors support decarbonization of the economy while being economically sustainable (Cong and Thomsen 2021).

Context and application

Local circular bioeconomies research has primarily been applied to urban and peri-urban settings in the Global North. Globally, these settings might be best fit for initial implementation as there is a need for a strong production-consumer base for local food and steep initial investment costs. At a broader scale, this model where food production, food processing, and energy production are integrated, hinges on a wider societal transition to circularity and circular economy. Such a transition requires support from industry, national, international, and global trade, and governance regulations, as well as engagement from civil society.

Relevant actors

Relevant actors include farmers of all kinds, land workers, local food and environmental social movements, municipalities, civil society (i.e., eaters), food processing facilities, corporate food distributors and retailers, agribusinesses and synthetic fertilizer manufacturers, local food hubs and incubators, and partnering research institutions. Local energy and waste management authorities are also vital for these projects to gain traction, as planning and executing the sorting and collection of biowaste and energy distribution are key elements in the success of local bioeconomies. Regulatory institutions at national and international levels such as the EU and WTO are also important actors in this transition, as they hold the power to change import regulations so as to foster the development of circular economies.

Implementation strategy

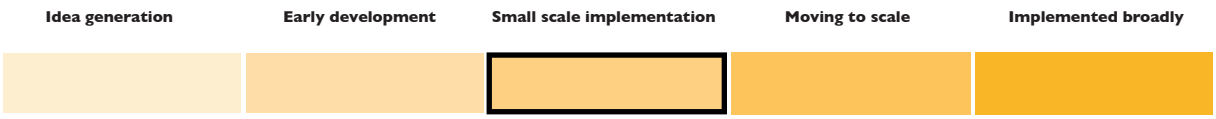
Small-scale application in canteens and other large biowaste producers has proven successful as a starting scale. Building on these experiences, literature suggests implementation at the municipal or neighborhood level to ensure uptake and commitment. Advocates need to support a societal change of mindset toward thinking circularity as part of food system solutions.

Challenges and barriers

In theory, local circular bioeconomies should be adaptable to all geographical settings; however, several factors may impede uptake. Existing strong communities and organizations and local

government priorities can work to either support or enable local circular bioeconomies (Vea, Romeo, and Thomsen 2018). Likely challenges include: (1) pre-existing food waste systems that may not seem adaptable to local production, or those that work at too large a scale to fit the purpose; (2) regulations that impede local decision-making at the municipal level; (3) local technological and economic path dependency; (4) lack of investments from larger companies or institutions to help cover the starting costs of small-scale producers; and (5) inability to shift consumer behavior and food preferences toward local produce and products, likely at a higher price. Consideration of these potential barriers during project development can help aid the selection of regions and municipalities.

Maturity



Implementation examples presented during the Transformation Labs group discussions mainly focused on Western European sites where local communities were the main beneficiaries. However, networks of local initiatives, such as those proposed by Helenius, Hagolani-Albov, and Koppelmäki (2020), could have great impact on land use practice globally.

Success criteria

- Economically and socially resilient networks of small-scale farming communities.
- Significantly reduced need for external inputs to the food system.
- Improved recycling of energy and nutrients.
- Shortened supply chains.
- Improved food security and sovereignty.
- Improved farmland biodiversity.
- Engagement of residents in their food system.
- Healthy and nutritious food for all.

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c. Multi-actor boundary partnerships at the interface of knowledge and action

Description

This working group proposes the creation of multi-actor boundary partnerships to serve as broker organizations between diverse food system actors to help translate global and national food system targets into regionally implementable initiatives. Sustainable food system transformations require context-specific knowledge. Multi-actor boundary partnerships can serve as broker organizations – between global, national, and regional governance levels, small-scale producers, public procurement, research, and civil society actors – capable of translating global and national food system targets into regionally implementable initiatives. Previous research outlines the key role brokers can play as intermediaries within complex actor webs (Bernard et al. 2023). Brokers specifically support the co-production of knowledge, innovation, and social learning (Bernard et al. 2023), align research agendas with policymaking timeframes, assign responsibility to actors, and transition activities from ideation to implementation.

Boundary work takes place at the interface between knowledge and action and ultimately works to change policies, routines, and collective knowledge (Farrell et al. 2022). Common boundary infrastructures used to support boundary partnerships include: brokers (individuals who facilitate interactions across organizations), practices (joint activities that bring together actors with varying interests), and objects (material and conceptual tools that enable joint activities) (Farrell et al. 2022). Within research, boundary partners have also been referred to as innovation brokers (Bernard et al. 2023) and research-practice partnerships (Farrell et al. 2022).

Successful boundary partnerships engage all four levers by channeling public and private funds (Economy and finance) into the process of aligning research agendas (Science and technology) with policymaking windows of opportunity (Governance). This process necessitates joint activity, the development of collective knowledge, and collaborative action among a range of actors (Individual and collective action). New boundary partnerships may benefit from building upon the work of existing actors working for common action in this field regionally, such as EU research projects, consultancies, and institutions. This may happen through living labs and other practice-oriented activities and by building networks and creating public awareness.

Context and application

The principle behind the idea of a boundary partnership is universally applicable. Nevertheless, each partnership must be based on the needs of the partners. Specifically, multi-stakeholder boundary partnerships may manifest as one brokering organization that links national policy-makers, researchers, and regional farmers. Alternatively, boundary partnerships may result in a more complex web of actors (including national-level negotiating teams at global conservation conferences, national and local governments, food entrepreneurs, food retailers and distributors, research consortia, grassroots social movements, civil society, youth organizations, women's organizations, and farmers of all scales) – all mediated by a single brokering organization.

Relevant actors

Multi-actor boundary partnerships inherently seek to engage a range of human and non-human actors, including actors with different agendas and goals within food systems. Relevant human actors within this type of arrangement include farmers of all scales – particularly, those who cultivate diversified, regenerative, and/or agroecological systems – research institutes, civil society, governments, local and international traders in agricultural commodities, and grassroots social movements. Other actors include specialized industrial agricultural industry actors who profit from monocultured agricultural and livestock systems and rely upon fossil fuel-based inputs (including synthetic fertilizers, pesticides, and herbicides), as well as the fossil fuel industry, and international funders.

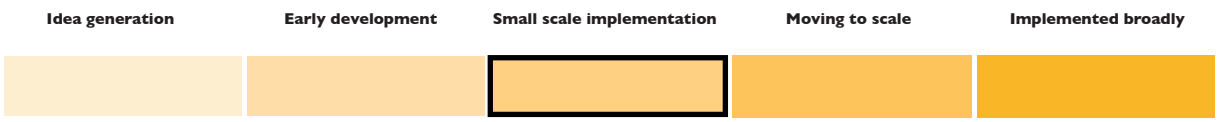
Implementation strategy

After the relevant partners are identified, public and private funds can be channeled to foster a boundary partner (i.e. intermediary organization) tasked with connecting stakeholders, assigning responsibility, coordinating joint activities, and facilitating the co-production of knowledge – all working to support the uptake of strategic approaches (Bernard et al. 2023). Practically, boundary partners can be NGOs, research groups, local authorities, extension services etc.

Challenges and barriers

Different timescales between stakeholders (i.e. length of electoral terms vs. number of growing seasons needed to qualify for certain organic or ecological certifications) is likely to emerge as a key barrier that prevents collaborative action toward transformation of food systems. Additionally, previous boundary work has evidenced clear challenges with integrating different types of knowledge, both from within and outside academia (Clark et al. 2016).

Maturity



Success criteria

Research highlight the importance of stakeholder participation, accountability in governance, and the use of boundary objects in successful boundary partnerships. Knowledge from generalized international research programs should aim to support, rather than replace, local lived experience and practice-based knowledge (Clark et al. 2016).

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d. Results-based payments for EU farmers

Description

This working group proposes the introduction of a results-based payment model, as opposed to a management-based model, to the EU's Common Agricultural Policy (CAP), where farmers receive direct payments for specific environmental results. Income support plays a major role in financing agriculture globally. In the EU, the CAP – a highly influential policy shaping the European agriculture and food system – has a budget greater than one third of the total EU budget (as of 2019) (European Commission 2019). However, despite being the largest source of funding for practical nature conservation in the EU, Agri-Environment-Climate Measures (AECM) implemented under the CAP (Herzon et al. 2018) have failed to halt rapid biodiversity loss, mitigate climate change, and prevent land degradation and soil erosion (Pe'er et al. 2020). To improve the ecological and social equity outcomes of farmer income support via the CAP, this working group proposes the introduction of a results-based (rather than size-based or management-based) payment model to the CAP. Under this type of model, farmers would receive payments for specific environmental results (Guimarães et al. 2023). Research suggests that results-based payments may mitigate loss of farmland biodiversity and support the provisioning of various other ecosystem services (Schmutz et al. 2022, Herzon et al. 2018). Furthermore, this model may be more appropriate for achieving several of the EU Green Deal targets, including a 50 % reduction of chemical pesticides and nutrient losses, and a 20 % reduction in synthetic fertilizers by 2030 (European Commission 2021).

Context and application

This idea is specifically applicable to agricultural production systems operating under the CAP within the EU. However, the principle may be adaptable to other regions with similar subsidy systems.

Relevant actors

Different actors with varied interests are relevant to the introduction of results-based payments to the CAP. These actors include the European Parliament, European Council, European Commission, EU member states, global environmental governance bodies, research institutions, farms, research institutions, private-sector actors within specialized industrial agriculture who profit from monocultured agricultural systems that rely upon fossil fuel-based inputs (including synthetic fertilizers, pesticides, and herbicides), and civil society.

Additionally, several non-human actors such as forests, grasslands, freshwater, and all species, including pollinators and soil communities, stand to benefit from each CAP payment that divests from the specialized industrial agricultural model and channels funding toward agro-ecological and regenerative approaches.

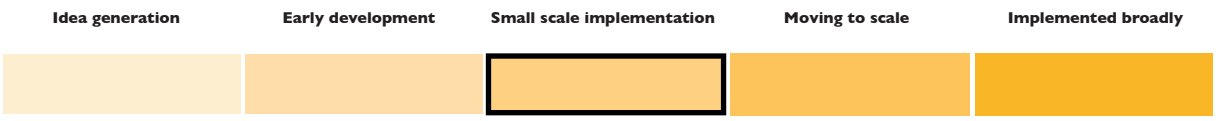
Implementation strategy

Several results-based payment schemes have been implemented within the EU on a small-scale basis (O'Rourke and Finn 2020). The Republic of Ireland has evidenced success since piloting three types of results-based payment projects in 2014 (Moran et al. 2021, O'Rourke and Finn 2020). However, to upscale these piecemeal pilot projects into larger programs, the European Commission must take an active role in expanding the use of the results-based payment model in the Agri-Environment Schemes (AES) implemented under the next CAP (Herzon et al. 2018). Proposing results-based payments as a focus group topic to the EU CAP network is one potential avenue for advancing collective knowledge on this area.

Challenges and barriers

Previous research has outlined several challenges associated with use of the results-based payment model. These include: (1) prohibitive costs associated with developing complicated, place-specific indicators and methods of measuring results, (2) determining parameters for what results are paid for, (3) the length of time required to achieve an outcome (thus, delaying payments to farmers), and (4) incapacities in developing and managing results-based payment schemes at the authority level (Herzon et al. 2018). Additional challenges may include path dependency and steep initial investments for farmers in transitioning from conventional to more agroecological practices, as well as a cultural shift in farmers' expectations regarding what constitutes ideal agricultural production systems.

Maturity



Success criteria

Results-based payments are successful when nature is positively impacted and when the farmers who receive results-based payments are involved in all phases of the scheme – as this helps to clearly communicate the objectives of the scheme, manage farmer risks, and support conflict resolution (Herzon et al. 2018). Lastly, results-based payments are successful when the indices and methods used to measure outcomes are easily interpreted by participating farmers.

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e. Verification systems using remote sensing for repurposed agricultural subsidies

Description

This working group proposes the supplemental use of satellite-based and remote-sensing technologies alongside information and communication technologies (ICT) to first (1) monitor and verify agricultural practices, and then (2) deliver appropriate payments of agricultural subsidies to farmers – particularly in the Global South. It is widely recognized that current agricultural subsidy systems worldwide can undermine sustainable agricultural transformation (FAO, UNDP, and UNEP 2021). This proposed idea follows the Food and Agriculture Organization of the United Nations (FAO) suggestion of repurposing agricultural subsidy systems away from support of environmentally harmful practices toward a more holistic and environmentally safe agriculture. One way of implementing this idea is to repurpose Monitoring, Reporting and Verification (MRV) tools for carbon emissions and alter these for the above purpose. MRV tools combine low-tech mobile phone services with satellite images and agricultural databases to verify and monitor environmentally safer agriculture and help countries to improve their reporting capacity. Supplementing in-person audits with remote-sensing technology can help ensure that personal circumstances, stories, constraints, and regional conditions are considered within the reporting assessment.

Information and communication technologies (ICT) play an increasingly important role in food systems and agricultural advisory systems in both the Global South and Global North. Monitoring and verifying agricultural practices using remote data may support low-emission agriculture and ensure better agricultural subsidy payment schemes (Perosa, Newton, and da Silva 2023), depending on the subsidy scheme and the criteria embedded in it.

In the Global South, farm-level monitoring and control is lacking, making it difficult to both evaluate the ecological state of farming and secure the payment of agricultural subsidies to smallholder farmers. Such farmers may benefit from easily accessible information and extension services received via text messages (Nakasone and Torero 2016). However, there is an underutilized potential for combining remote-sensing systems with ICT in the Global South – to first verify agricultural practices and then deliver appropriate payment of agricultural subsidies to farmers.

Nakalembe and Kerner (2023) suggest the application of Artificial Intelligence Earth Observations (AI-EO) for agricultural purposes in Sub-Saharan Africa and stress the need for stakeholder involvement and end-user focus among other recommendations to increase AI-EO in Africa. The technology has potential to support agricultural development, and if combined with environmentally conscious practices and policies, AI-EO may support a transition toward global sustainable food systems (Nakalembe and Kerner 2023). The working group highlights the underutilized potential of combining these technologies with repurposing agricultural subsidy schemes to promote sustainable and regenerative agricultural practices in the Global South. For such a model to work, however, there is a critical need for education and training at farm level as well as safeguards to ensure that technologies are developed and adapted for local purposes that promote sound agricultural practices. This includes careful attention to the content of the subsidy system itself. At the governance level, the agricultural subsidy payment system needs to be adapted to incorporate remotely sensed information. This requires reshuffling the control mechanisms away from soley in-person audits and building trust in the remotely sensed data – for both farmers, the farm advisory system, and the relevant governing bodies.

Context and application

The idea focuses on Global South agriculture. However, it might be used in all agricultural areas, in particular areas where small-holder farming is the main agricultural system. Several satellite-based monitoring systems already cover the African continent (Nakalembe et al. 2021). Uptake of this research must consider social and economic settings, the on-the-ground reality of agricultural extension services, and technological limitations, such as Internet access, smartphone/non-smartphone usage, and server downtime. The idea can be applied to all rural settings, but it relies upon uptake by agricultural advisors, farmers, and local structures of governance.

Relevant actors

Relevant actors include smallholder farmers, agricultural advisors, government agricultural extension agents, mobile banking companies and their business partners (including front-end and back-end designers of systems and apps). At the governance level, the relevant ministries of the environment, agriculture, and finance all need to align on supporting the rollout of this system, which will need to be adjusted to the specific agricultural subsidy systems in use. Moreover, the chosen technological systems play an important part as a relevant actor, as choice of technology and price will greatly affect uptake and distribution.

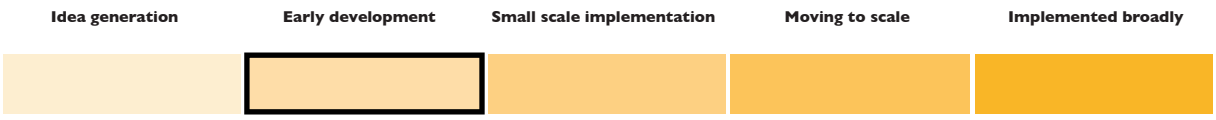
Implementation strategy

Implementation of this idea depends on simultaneous and coordinated development of 1) an agricultural subsidy scheme supplemented by remote data, 2) useful monitoring criteria and technologies, and 3) education and training on using and implementing this system for agricultural extension agents and farmers alike. Moreover, a farm-level advisory system and an agricultural extension system are necessary to develop these technologies as their use at farm level must temporarily align with agricultural subsidy systems that depend on remote sensing and satellite imagery. Lastly, to gain traction, this suggestion needs publicity through media campaigns and the support of farmers, local governance institutions, and media platforms.

Challenges and barriers

As the system needs to combine technological systems with financial aid, there are several challenges to the implementation of this idea. Remote-sensing technology may lack the capacity to differentiate between conventional agriculture practices and more multifunctional and diversified agroecological practices (requiring more on-the-ground, community-based methods of verification). This may ultimately disincentivize smallholder farmers from transitioning to more sustainable farming practices. Thus, remote data cannot replace site visits, but rather supplement them as a tool to assist farmers in developing in the way they desire. Strengthening agricultural extension and farmer community networks may be one avenue for addressing these barriers. Lastly, there are risks of high costs in maintenance of systems and possible aversion to uptake due to perceived risks and costs among farmers.

Maturity



Using remote sensing for agricultural subsidy payments is still in its early development as both the subsidy system and the technological system would need to be repurposed. However, some examples of similar systems are in use, such as the Kenyan telemobile company Safaricom's platform Digifarm, which provides low-tech farm advice and access to agricultural loans through mobile-based systems (DigiFarm n.d.). Additionally, research on MRV tools indicates that the concept has potential for further development and broader implementation.

Success criteria

In the short term, this idea would be successful if actual agricultural subsidies in the Global South are repurposed to incorporate this technological system. Long-term success criteria include the development of environmentally safe smallholder farming that is economically and socially just. This includes: (1) more economically resilient agricultural households, (2) increased adoption of sustainable farming practices, and (3) more efficient and equitable distribution of agricultural subsidies. Lastly, the success of this idea can be measured by its ability to create a positive impact on the environment, local communities, and the overall food system. To evaluate the success of the project, data collection and monitoring efforts should be implemented to track changes in farming practices, the adoption of new technologies, and the impact on the livelihoods of smallholder farmers.

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ENTRY POINT 4

Energy decarbonization with universal access

Energy is a requirement for economic and human development. However, there is still a long way to go to provide access to affordable, reliable, and sustainable energy for all, as stated in the Sustainable Development Goal 7 (UN 2022). Today, 770 million people lack access to electricity, mainly in Africa and Asia. Additionally, the COVID-19 crisis has impacted electrification efforts negatively, manifested in a global increase in people without access to electricity in 2020, for the first time since 2013 (IEA 2022). Simultaneously, the current energy system is one of the main contributors to climate change through the emission of greenhouse gases. Energy combustion and related industrial processes emit more than 35 gigatons of CO_2 annually, a figure that is still increasing (IEA 2023). To make sustainable energy available to all, we need context-specific solutions that do not lose sight of the importance of interconnections between the energy system, the environment, and society. We can drive change by increasing green energy production, transportation, and usage efficiency, and by changing our priorities and behavior. This will allow us to transition from a fossil fuel-based to a net-zero society (UN 2023). Solutions that include renewables as the primary source in the energy mix, and which increase efficiency in the production, transportation, and utilization of energy, are needed. Additionally, the IPCC synthesis report suggests that deploying carbon capture and storage technologies, as well as using alternative energy carriers and improving the energy system integration, will be necessary to reduce emissions from sectors that cannot easily replace fossil fuels (IPCC 2023). Various approaches to implementing these solutions were discussed during the Transformation Labs process. It became evident that tailoring these solutions to the needs of each region is of the utmost importance, since scenarios and challenges regarding energy access and decarbonization differ significantly.

The following ideas result from the Transformation Labs discussions on universal energy access and decarbonization. We do not consider them a complete road map to a sustainable energy system. Instead, they represent the background of the participating scientists and practitioners and the converging reflections of the group. Limiting our energy consumption, building renewable energy capacity, and managing residual emissions is necessary for transitioning toward a sustainable energy system. The proposed ideas can play a role in achieving these targets.

Group Facilitators

Phebe L. Bonilla P.
I am a postdoctoral researcher at the Danish Technical University, focused on reducing greenhouse gas emissions from landfills. In addition, I work as a research communicator at Research Retold, where collaborate with other researchers to make science accessible and actionable. As a facilitator of the Transformation Labs initiative, I focused on refining the participants' research insights to highlight concerns and possible action paths towards sustainability.

With assistance from:
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Bachelor in technology management and marine engineering from Aarhus school of Marine and Technical Engineering. Currently works as a BMS engineer.

Simon Lex
Associate Professor at the Institute of Anthropology of the University of Copenhagen. His work focuses on green transition, community building, and renewable energy.

a. Implementing carbon capture and storage technologies

Description

Around 80 % of the global energy supply for electricity, heating, and transport in 2020 came from fossil fuels (IEA 2021), which accounted for 73.2 % of global greenhouse gases (GHG) emissions (Ritchie, Roser, and Rosado 2020). Thus, reducing carbon emissions in energy production could reduce global GHG emissions significantly. Existing strategies for carbon dioxide removal (CDR) include both nature- and technology-based solutions. Although nature-based solutions, such as forest management, provide additional benefits, notably to biodiversity, they are limited by land availability, and the removed carbon is prone to release due to climate change effects (Smith et al, 2023). Other nature-based solutions such as capturing CO_2 with seaweed are still under development (Laurens, Lane, and Nelson 2020), and their effectiveness remains to be assessed. Using these CDR methods alone will not be enough to capture all the CO_2 that needs to be removed from the atmosphere in the short term.

We propose promoting technology-based solutions such as carbon capture and storage (CCS) technologies for addressing hard-to-abate emissions. We consider CCS technologies a crucial priority in the process of decarbonizing the energy system and achieving the target of keeping the increase in global temperatures below 1.5 °C (IPCC 2023). We want to stress that their efficiency in terms of energy consumption and cost must be improved, and that collaboration between industries and countries is necessary if regulations are to be genuinely effective. Most importantly, CCS technologies must be seen as a bridge toward a net-zero society and not as the only or final solution to emission reduction.

Context and application

CCS is most effective with large, stationary sources of CO_2 emissions, including industrial sites and power plants, because the flue gases can be treated when concentrated, resulting in more efficient use of the energy and resources needed to capture the carbon. This is not to say that capture technologies cannot be used for mobile sources. Direct air capture (DAC) focuses on removing CO_2 emissions directly from the atmosphere where the concentration can be two-three orders of magnitude lower than in concentrated sources (Erans et al. 2022). DAC technologies are under development, but incipient commercial projects exist, such as the ORCA plant in Iceland run by Climateworks. While DAC is beyond the scope of this idea, more information on this topic can be found in Erans et al. (2022).

Most of the existing CCS facilities in operation focus on natural gas processing, hydrogen, fertilizers, synthetic fuels, and power generation (IEA 2022). Due to the different applications of CCS technologies, many companies related to the fossil fuel and chemical industries are investing in CCS to reduce their emissions, mainly in the US and China. This is reflected in the list of top owners of CCS patents between 2001 and 2018, which includes renowned brands such as, Mitsubishi Heavy, GE, LG Electronics, Toshiba and Samsung (IPO 2021).

Bonilla Prado (2022) lists the three main carbon capture methods currently in use:

- Pre-combustion: Before the fossil fuel is burned, the hydrogen is separated from the carbon to make sure the produced flue gases do not contain carbon.

- Oxy fuel: During combustion, the fuel is oxidized using pure oxygen instead of air. This creates a concentrated stream of CO_2 as a flue gas.

- Post-combustion: After combustion, the flue gases are separated using chemical absorption, physical adsorption, or membranes, among other methods. This is the most common approach implemented at a commercial scale, as it is easier to implement in existing facilities.

Each carbon capture approach has its advantages and disadvantages, and the choice of capture technology must be analyzed case by case. This decision impacts not only the efficiency of carbon capture, but also the cost. Estimations of the capture cost range widely from USD 15 to 75 per ton of CO_2 (Fan et al. 2012). Research aimed at reducing capture costs is ongoing. Projects such as FEED in Australia are on the way to reducing CO_2 abetment cost to USD 22 per ton of CO_2 (Page, Turan, and Zapantis 2020). In the international arena, CCS implementation has been aided by government policies incentivizing private-sector investment. For example, North America, mainland Europe, and the UK have maintained or strengthened their support for carbon capture utility and storage (CCUS). Recent developments in North America include passing the Infrastructure Investment and Jobs Act, the provision of USD 12 billion for CCS and related activities in the US, and the establishment of tax credits for CCS projects in Canada (e.g. Saskatchewan). The EU has allocated EUR 5 billion in subsidies to CCS, and the UK has produced a CCS Investor Roadmap to deliver four CCS low-carbon industrial clusters by 2030. The Asia-Pacific region is also advancing in CCS policy with Japan, China, Indonesia, Malaysia, and Thailand all taking steps to develop legislation for geological carbon dioxide storage (Global CCS Institute 2022).

Relevant actors

- Private sector: Companies that emit a significant amount of CO_2 must collaborate and promote the creation of industrial clusters that share infrastructure and best practices to accelerate CCS adoption and improvement (DBEIS 2022). Communication activities between those implementing CCUS projects and the local, impacted communities must clarify the benefits and challenges of the technologies in an accessible and transparent manner. More information of the evaluation of the social impact of CCS projects can be found in research by Rafiaani et al. (2020).

- Universities: Collaboration between the private sector and universities can accelerate the creation of new carbon capture technologies that are more efficient and sustainable than the chemical absorption technology that dominates commercial applications, such as adsorbent materials (Akinola, Bonilla Prado, and Wang 2022).

- Governments: Local governments can incentivize private investments in CCS projects through policies and tax exemptions. Care must be taken to facilitate the transportation of captured CO_2 across borders from emitters to the geological formations for final storage.

Implementation strategy

At the governance level, implementing regulations for limiting GHG could accelerate the adoption of CCS technologies. CCS projects are primarily incentivized by profitability or the obligation to comply with more stringent emissions regulations. One way to create an income from CCS projects is to pair them with carbon utilization applications, such as enhanced oil recovery (EOR), CO_2 conversion to fuels and chemicals, e.g. methane, methanol, gasoline, diesel, and even producing products from microalgae (Erans et al. 2022). Nevertheless, carbon utilization projects are still incipient, and their scalability is being tested. For example, the ElbBlue ship showed that it is possible to power container ships with synthetic natural gas, however this remains expensive (Cero 2050 2021).

In many cases, CCS projects have been linked with EOR to facilitate faster return on investment, making them dependent on oil prices. One of the most important case studies of how this can significantly affect projects is the power plant Petra Nova. It was the carbon capture flagship project in the US by 2017, but for several reasons suspended operations in 2020, including a drastic drop in oil prices during the Covid-19 pandemic (Anchondo and Klum 2020, Mattei and Schlissel 2022). Developing other mechanisms that can make CCS financially viable, such as carbon taxation or a cap-and-trade system, is key to generating

broader adoption. The advantages of a carbon pricing scheme are that it can be applied to all GHGs, it encourages producers to decrease the carbon intensity of the energy and industrial sectors, and it creates opportunities to increase profitability through the reduction of GHG, incentivizing the generation of new ideas (High-Level Commission on Carbon Prices 2017). Additionally, reducing fossil fuel subsidies and creating policies that allow CO_2 transportation across borders will enable the generation of international networks of companies and universities that can share and exchange knowledge and experience on how to implement CCS technologies. The creation of hubs or clusters can further accelerate the development and spread of new CCS technologies. These networks can bring together institutions working on CCS, CO_2 emitters, and storage locations and promote the use of shared transportation infrastructure (Global CCS Institute 2016). Examples of such clusters are the ACORN project in the UK aiming at reducing emissions from two gas terminals, the Northern Lights project delivering cross-border transport and storage services, the ACCESS project that focuses on different CCS innovations across Europe, and the C4 – Carbon Capture Cluster Copenhagen which seeks to reduce carbon emissions by three million tons of CO_2 per year. As case studies, these projects have highlighted the benefits of collaboration within the industrial sector by sharing insights and data among their contributors.

Challenges and barriers

Regarding the technical aspect, carbon capture technologies tend to be expensive and demand a large amount of energy. Further research on how to make them more efficient and use less raw materials and energy is required (Akinola, Bonilla Prado, and Wang 2022). For example, utilizing excess heat from industrial processes for CCS could reduce the energy requirements (Eliasson et al. 2022). On the political side, enhanced national commitments to achieving net zero and commercial opportunities have led to a greater interest in CCS deployment and new policy generation. New policies and regulations are crucial to foster interest in the private sector in investing in CCS and to ensure cohesion among projects to avoid isolated efforts. Other challenges associated with the regional implementation of CCS projects relate to the transportation of CO_2 from one country to another for storage (Global CCS Institute 2022). International collaboration will help overcome the obstacles of limited geological storage availability for scaling CCS, as regulations and infrastructure must be reconciled among nations if the concept is to be broadened. Additionally, in some cases, the implementation of local CCS projects fails to consider citizens' rights and preferences, generating opposition to the development of CCS facilities, as is currently the case in Iowa (Splitter 2022). Consequently, better models for public engagement and participation are needed. Finally, some are opposed to the development and implementation of CCS technologies out of fear that they will be used by the oil industry to continue business as usual. These technologies

must be used as a transitioning tool for achieving a net-zero society, rather than as a final solution for the GHG emissions problem. Investment in CCS should not hinder the development of more sustainable energy sources or processes, and thus funding should be allocated separately.

Maturity

By September 2022, there were 196 CCS facility projects worldwide, which was an increase of 44 % from the previous year (Global CCS Institute 2022). 35 of these facilities are considered projects at a commercial scale and add up to 45 megatons of CO_2 capture capacity. This is a significant development, but not nearly enough considering the 49.4 billion tons of CO_2 emitted a year (Ritchie, Roser, and Rosado 2020).

Success criteria

The successful implementation of CCS projects can be evaluated mainly by the avoided CO_2 emissions. Another indicator of success of these projects is the jobs created by transforming the current energy system to a more sustainable one. The number of large-scale operating projects and the number of active clusters and patents of more efficient carbon capture technologies can also be utilized as a success criterion to track the progress of CCS implementation.

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b. Assessing and preventing possible rebound effects of new technologies

Description

New technologies are becoming increasingly accessible and integrated into our daily lives. Thus, we need to consider their potential impact and unintended consequences on the environment and society at a large scale and in the long term. Among these consequences, rebound effects became a key point in our group discussions while we considered the potential environmental impacts of transforming the energy system to solely relying on renewable sources.

Rebound effects occur when technology improvements lead to increased efficiency and higher accessibility, which in turn rebounds in the economy through increased consumption of the technology or spending of the saved money elsewhere, leading to an increased environmental impact. There are three categories of rebound effects related to energy (Gossart 2014):

- Direct: When a lower energy price triggers a higher demand for the cheaper goods or services. For example, if washing machines needed less power or the power was cheaper, people could afford to wash their clothes more frequently, reducing the overall energy savings.

- Indirect: When the savings derived from increased energy efficiency are allocated to consumption of other goods and services. For example, if a family insulated their apartment windows and thus saved money on heating, they could use that money to fly on holiday at a far-away destination, which would even out the environmental benefits.

- Economy-wide: When a reduction in energy prices triggers modifications to production patterns and consumption habits. For example, low-price gasoline enables people to drive more frequently or longer distances, which increases the number of vehicles on the road.

The importance of rebound effects cannot be underestimated. It has been estimated that economy-wide rebound effects can erode more than 50 % of the savings gained from energy efficiency improvements (Brockway et al. 2021).

In line with the work of Font Vivanco, Kemp, and van der Voet (2016), we urge policymakers to consider rebound effects in the creation and implementation process of new policies and programs. A starting point could be to make rebound effects analysis a requirement in sustainability assessments (as emphasised in idea c. ”Improving current methodologies for

sustainability assessment", found within this section), implementing cap-and-trade schemes which ensure that we live within planetary boundaries, and giving consumers access to consumption information, enabling them to change their behavior to more sustainable practices.

Context and Application

Although the concept of assessing and preventing rebound effects of new technology can be globally implemented, the analysis should be tailored to specific socio-economic and geographic contexts. Social and environmental implications of new technologies will vary from place to place, and so should the adaptability of the market and regulations introduced to minimize potential rebound effects. Models which use contextualized data to analyze multiple scenarios that show possible long-term, large-scale outcomes of regulations on new technologies can also lessen rebound effects. To clarify this, we shall provide an example.

The use of electric vehicles (EVs) is a potentially problematic solution to decarbonizing the transportation sector. Although they considerably reduce greenhouse gas emissions from fuel combustion, the emissions reduction is linked to the electricity source. If the energy comes from a fossil-fuel power plant, the emissions have simply shifted from the car exhaust pipe to the power plant. This may create an indirect rebound effect, as the user of the car increases the number of trips taken, while energy producers who must comply with emissions regulations have to find a solution to the increased demand. It could be an advantage if these power plants implemented a carbon capture unit. However, the current number of operating carbon capture facilities around the world is very low. For more information on this topic, see idea a. "Implementing carbon capture and storage technologies".

EV batteries contain lithium and other rare metals. As EVs become more accessible, how to mitigate the environmental impacts of mining these metals and treating the discarded batteries remains unanswered. Furthermore, we do not have enough of these metals to substitute all vehicles in demand (Shine 2022). Additionally, existing regulations intended to accelerate the vehicle fleet change can result in the acquisition of more vehicles, increasing traffic and reducing the use of public transportation, as has been reported for Norway (Aasness and Odeck 2015).

Carrying out sustainability assessments that consider the resource extraction impact on the environment and the necessary actions to reduce pollution generated in connection with the scrapping of EVs could help determine measures to mitigate their environmental impact, while policy scrutiny could suggest adjustments to enable a more desirable outcome in the long term, e.g. by creating a cap system for the emissions generated or reducing subsidies that would artificially increment product demand (Font Vivanco, Kemp, and van der Voet 2016).

Relevant Actors

- Private sector: Companies developing new technologies must analyze the possible impacts, both intended and unintended, that a new product or service will have on society and the environment. Estimates of economy-wide rebound effects can be obtained using different models, e.g. computable general equilibrium models, growth accounting techniques, econometric analysis, and integrated assessment models, to name a few (Brockway et al. 2021). Font Vivanco, Kemp, and van der Voet (2016) highlight the need for new business models that are more efficient when it comes to the use of resources and access to consumption information. Confronting consumers with their individual consumption levels, e.g. using smart meters, can help to reduce the direct rebound effect from efficiency improvements. The private sector can play a key role in this by sharing adequate and sufficient information with consumers.

- Universities: Institutions of higher education must increase awareness of the existence of rebound effects and prepare future professionals for considering them when developing new technologies. This should happen both in university research and in the private sector. Additionally, universities could provide training to researchers and other interested stakeholders in the use of available models for analyzing rebound effect scenarios.

- Governments: (Inter)state institutions that enforce regulations can demand from technology developers an analysis report of different scenarios representing the possible consequences of the large-scale use of any new technology before authorizing its release. Furthermore, policies for reducing rebound effects in the energy system should set a cost-effective ceiling to total energy use and its environmental impact, such as CO_2 emissions. These can take the form of taxes or tradable permits, focusing mostly on changing behavior rather than technology (Van den Bergh 2011).

Implementation Strategy

A starting point could be to promote holistic sustainability assessments that set biophysical limits or carrying capacities, which define a space to which human activities must limit themselves. The analyzed rebound effect scenarios could be compared to these limits. Having a concrete "pollution space" would put pressure on companies to reduce their impact per product. An example of this approach is the Science Based Targets initiative (SBTi). On the other hand, at governance level it is important to identify and evaluate different steering mechanisms to prevent rebound effects. Instruments such as benchmarking tools, targeted eco-innovation, energy/carbon taxes, bonus-malus schemes, and cap-and-trade systems

have been analyzed as potential solutions (Font Vivanco, Kemp, and van der Voet 2016). An example of a cap-and-trade system for emissions is the International Carbon Action Partnership (ICAP), which brings together countries and regions and supports the development of domestic carbon markets through the Partnership for Market Readiness platform.

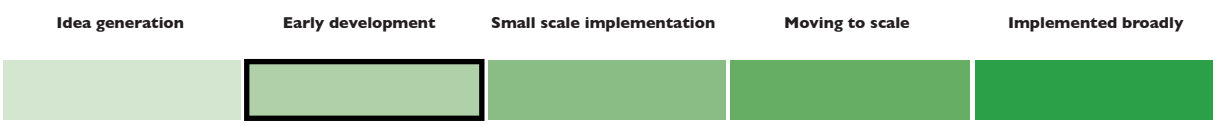
Collaboration between the private sector and universities to promote dialogue and increase awareness of rebound effects can accelerate research on methodologies for estimating rebound effects. Communicating the findings of such research to policymakers and to the public could steer policy and dialogue toward scenarios with reduced rebound effects.

Challenges and barriers

Rebound effects for energy conservation are more likely to affect developing countries due to several factors (Van den Bergh 2011). For example, their high growth rate entails a rapid accumulation of energy-using technologies. Furthermore, energy costs in these countries tend to be higher, and so does the financial gain associated with energy conservation. In turn, savings are spent in other areas. Meanwhile, current methodologies for analyzing rebound effects encounter different methodologic and data-oriented limitations in terms of both defining the system of measurement and obtaining relevant information for defining the values of the parameters of the models (Brockway et al. 2021). In addition, companies and institutions developing new technologies may oppose the introduction of more comprehensive assessments intended to prevent rebound effects of new technologies. It must be noted that poor implementation of assessments, cap-and-trade systems, and access to consumption information can result in cumbersome paperwork, rather than being an effective tool.

Care must be taken when defining what is required and who will be responsible for revising assessments, implementing cap-and-trade systems, and providing accurate information. Fostering collaboration between the private sector and universities could enable dialogue between stakeholders who have the needed experience to constructively criticize the assessments.

Maturity



Success criteria

The effectiveness of assessing and preventing potential rebound effects of new technologies cannot be directly measured. However, the number of institutions, private and public, requiring this type of analysis could indicate the level of awareness. On the other hand, having more and better models for estimating rebound effects could also be a success criterion. Finally, the number of policies based on rebound effects analysis can be tracked, as can the effects of their implementation.

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c. Improving current methodologies for sustainability assessment

Description

Sustainability assessment (SA) methodologies can provide valuable support in decision-making for implementing more energy-efficient and universally accessible projects. However, while debating different solutions for reducing the environmental and social impacts of the creation, distribution, and use of energy, it was the group's perception that more efforts are needed to tackle the social impact of energy projects and processes on communities. Social impacts vary widely in their scope and consequences. If positive, they can include increased access to energy and productivity. If negative, outcomes can range from opposition to the construction of renewable energy projects and extending the consent for existing infrastructure (Windemer and Cowell 2021) to the forced displacement of communities due to the construction of hydroelectric power plants (Hay, Skinner, and Norton 2019).

Evaluating the social impacts is a challenge that has already been identified within the life cycle assessment (LCA) community and has been addressed by including the social life cycle assessment (SLCA) into the life cycle sustainability assessment (LCSA) (Cinelli et al. 2013). Nevertheless, SA encompasses a wide and continuously evolving range of processes that go beyond LCA. LCA is just one of the various analyses available for carrying out an SA, along with multi-criteria decision analysis (MCDA), environmental impact assessment, and sustainability appraisal. In this text, we take the SA concept from Pope et al. (2017), who view SA as any forecast-based process that aims to direct decision-making toward sustainability, applicable to projects, programs, and policies. Following this vein of thought, the following ideas are intended as a starting point for improving these processes:

1. Further developing more comprehensive methodologies that include social impacts and prioritize community involvement: Currently, the evaluation of economic and environmental impacts tends to be more mature in SA, because their quantification is more straightforward, while methodologies that assess social impacts are less developed (Rafiaani et al. 2020). Refining the evaluation of social impacts in SA could address human health, social well-being, and prosperity, as in the case of the PROSUITE project (Cinelli et al. 2013). If SA focuses on a project, other criteria to consider could include community and stakeholder engagement, workforce management, housing and accommodation, local business and industry procurement, and health and community well-being (Department of State Development, Infrastructure, Local Government and Planning 2018).

Furthermore, rebound effects of technologies must be considered in the light of their social impacts. For more information about rebound effects, please see Font Vivanco, Kemp, and van der Voet (2016).

2. Democratizing, communicating, and adapting current SA methods to foster their implementation and promote their improvement: The lack of knowledge exchange between those implementing SAs slows down the learning process that could accelerate the creation and implementation of better methodologies. For example, existing standards, such as ISO 14040:2006 (ISO 2022a) and ISO 14044:2006 (ISO 2022b), for LCA and life cycle inventory must be bought. This can be a deterrent for small and medium-sized enterprises if they are not aware of open-access alternatives such as the product environmental footprint (PEF) proposed by the European Commission (European Commission 2021).

   Publishing open-access methodologies and sharing them in different languages could increase their dissemination and thus their implementation. On the other hand, to improve SA methodologies' usability those implementing them must also provide feedback on their applicability in their specific context to the organizations publishing them. For example, in the case of MCDA, some software tools for facilitating SA are perceived as a black box and require demanding cognitive efforts from decision-makers when it comes to carrying out the analysis and understanding the results (Cinelli, Coles, and Kirwan 2014). Making the implementation tools more accessible and easier to understand is fundamental for decision-makers to feel more comfortable using them and understanding which SA methodology is the best fit for their endeavor.

3. Creating a minimum set of requirements to be included in SA across sectors and countries: In some cases, the lack of guidance on how to assess sustainability results in lax evaluations. This enables "greenwashing" of products and services that portray themselves as sustainable or environmentally friendly without enough evidence, or whose claims are based on SAs that are very narrow in scope. We could ensure better quality and more comprehensive assessments by setting a minimum standard. This is not to say that SAs should be carried out under a constrained framework that does not allow space for new technologies or products. Rather, we caution against too vague frameworks that leave space for biased interpretations. The creation of a global regulation on sustainability reporting for corporations based on absolute environmental indicators was addressed by idea e in entry point 2, Sustainable and just economies. The suggested absolute environmental indicators could be a starting point for improving SAs globally.

Context and application

Bond, Morrison-Saunders, and Pope (2012) propose that SA is universally applicable if seen as any other process that directs decision-making toward sustainability, from individuals in their everyday lives to projects, plans, programs, or policies. We agree with this and recognize that the actual implementation of the assessment depends on many factors, including the conceptualization of sustainability of each context and the governance structures and their decision-making processes. Stevens (2008) suggests a few general guidelines that can be implemented regardless of the context, including being clear on the levels and objectives of the assessment and deciding on its depth and the required tools – e.g. determining whether the assessment is for a new national policy or a local project, whether it is a quick scan or a detailed analysis, and whether it requires qualitative or quantitative data. While carrying out the assessment, the short- and long-term impacts must be included, along with synergies, cumulative effects, and possible conflicts between the environment, economy, and society. It is crucial to identify alternative paths and scenarios when creating new policies, and to present the assessment's findings to policymakers and stakeholders in an accessible and actionable manner. Regarding the inclusion of the social aspects of SA, a starting point is the creation of a social baseline describing the existing conditions and trends, as suggested in the Social Impact Assessment Guideline from the Queensland Government (Department of State Development, Infrastructure, Local Government and Planning 2018). For example, analyzing the present level of unemployment can strongly affect the social relevance of a new policy or the deployment of a new technology (Jørgensen et al. 2010). Such analysis provides a benchmark for comparing impacts. The baseline can include a demographic profile of potentially affected communities and an analysis of their characteristics, such as culture, values, history, land ownership, utilization of natural resources, available accessibility infrastructure, housing market, labor market, and ongoing projects. The baseline information can be supplemented with an overview of land use and key industries in the region and their role in local and state government plans (Department of State Development, Infrastructure, Local Government and Planning 2018).

Relevant actors

- Private sector: Collaboration between industry and universities is crucial for further developing and refining SA methodologies. In these partnerships, the self-reflecting nature of research could provide insights for improvement of the usability of SA tools, while the industry could provide the required data to determine what criteria and approaches are best for different projects. It must be pointed out that in some cases companies might resist the implementation of more stringent SA, since the cost of implementing mitigation

measures or investing in social projects might not be in their budget or even in their objectives. If improved methodologies are to be successful, there should be a change in values and priorities in the private sector.

- Government: Local governments can monitor compliance with these methodologies and their dissemination to ensure transparency and accountability. For example, the enforcement of environmental, social, and governance (ESG) reporting as a mandatory practice – in conjunction with more defined guidelines for establishing a minimum baseline of disclosure associated with sustainability metrics in the private and public sectors – can provide a solid ground for improving the uniform application of such methodologies. Furthermore, governments can benefit from the results of SAs for evidence-based decision-making in the implementation of policies aimed at sustainability.

- Universities: Researchers, including researchers within the social sciences, can collaborate with the private sector to enhance and disseminate the assessment methodologies. Additionally, educational institutions and universities can raise awareness of the importance of SA.

- Local communities and NGOs: Local communities should benefit from the implementation of improved SAs. By holding other actors accountable, citizens can put pressure on organizations and institutions to carry out more comprehensive assessments and reporting.

Implementation strategy

Improving international standards for SA could improve transparency in the private sector, shifting the objectives from economic profit to well-being, as described in entry point 1: Human well-being and capabilities. As a first step, governmental regulations could make SA an obligation, a process that has already started. In addition, the European Union recently enforced the Corporate Sustainability Reporting Directive (CSRD) which makes it mandatory for companies to audit the sustainability information they report, including details of ESG (European Parliament 2022). Social impacts that could be integrated into the assessments include the evaluation of changes to communities' values and how they function, changes to culture, livelihoods, and ability to access cultural resources, exposure to hazards or risks, and impacts on well-being (Department of State Development, Infrastructure, Local Government and Planning 2018). This is not a comprehensive list, but an exemplification of current efforts for evaluating social impacts. Having a list can increase awareness of the full range of possible impacts. However, it is important to avoid using it as a checklist without proper scouting of the context. Any assessment must take into consideration the context-specific parameters

that shape the case at hand (Vanclay 2002). Projects that carry out SA with new and more comprehensive methodologies can face different challenges in cases where non-compliant supply chains have an economic competitive advantage. That is why the creation of policies and regulations that require better SAs is necessary to provide equal opportunities. Fortunately, technological advancements and legislation and market changes have made the green transition more profitable. As an example, sunlight and wind are the cheapest options for new electricity generation in most countries (IEA 2022). The implementation of the improved SA can therefore be expected to overcome the economic competition challenges in the long run. Improved SA methodologies should be open access to increase their availability. One way to improve their dissemination could be to create user-friendly sustainability reporting (web) platforms that directly implement methodologies (in the backend) and translate them into easy-to-understand impacts, accessible to decision-makers. In addition, providing clear reporting guidelines or a set of minimum assessment requirements for the private sector can improve the quality of their assessments and facilitate their contribution to the creation of better databases for refining assessment methodologies. The energy sector fuels the industry, transportation, and the building sector. Together, these sectors accounted for 79 % of greenhouse gas emissions in 2019 (IPCC 2023). Improvements in social and environmental SA methodologies might provide effective tools to drive a green transition not only in the energy sector, but also in its interconnected sectors. This is of even greater concern when considering that the global energy demand is forecasted to grow in the future, especially from Asia's emerging markets and developing economies (IEA 2023).

Challenges and barriers

A major challenge is a lack of dissemination and accessibility. For example, general guidelines such as ISO 2006:14040 and ISO 2006:14044 for carrying out LCA are internationally known, but they are not widely implemented due to the lack of political will and resources. There are initiatives to provide public access to LCA guidelines, such as the "International Reference Life Cycle Data System (ILCD) Handbook – General guide for Life Cycle Assessment – Detailed guidance" (Wolf and Chomkhamsri, et. al. 2010). Nevertheless, further efforts are needed to bring this information closer to those who need them.

It must be noted that the effectiveness and applicability of these improved SA methodologies is constrained by the quality of datasets adopted in the impact quantification step. Quantitative and qualitative data are necessary to create baseline scenarios and evaluate alternatives. By enriching datasets with information from past experiences, SA forecasts can become more accurate. To improve these datasets, it is essential to understand what obstacles hinder private companies from sharing data that would allow a sensible refinement of the datasets.

Accurate and high-quality information would be highly beneficial to better design incentives and refine regulatory frameworks. An open dialogue between the private and public sectors is required to determine which methodologies can or should be implemented as regulations, and how governments can support a gradual transition.

Maturity

SA can be seen as a third generation of impact assessment. The first – and simpler – impact assessment evolved into environmental impact assessment, widely implemented in over 190 countries in the past decade and promoted as a tool for decision-making (Bond, Morrison-Saunders, and Pope 2012), with the social aspect currently gaining more attention.

Success criteria

- Creating a minimum set of requirements for SA methodologies that integrate the social, economic, and environmental aspects of sustainability. This framework should be flexible enough to accommodate different areas, as well as new technologies and processes, while providing not-too-lax guidelines to avoid biased interpretations. It should also contain recommendations on the applicability of these requirements in relation to different contexts. Suitability of regulations could be evaluated, e.g. depending on the subject of assessment (project, program, or policy), the objective of the assessment (level of sustainability, what the best alternative is, or contribution of sustainability), and the responsible partners (regulators, proponents, and third parties) (Pope et al. 2017). This minimum set should be publicly accessible and promoted by local governments and SA practitioners.

- Increasing number of high-quality, open-access regional data sets. Existence of open-access repositories dedicated to SA data and the results from the evaluated projects/program/policies can accelerate knowledge exchange and SA methodology improvements and implementation. Standardized platforms that can be integrated with user-friendly services to quantify sustainability impacts could increase accessibility.

- An increasing number of knowledge-exchange case studies for the implementation of improved sustainability assessment methodologies.

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ENTRY POINT 5

Urban and peri-urban development

Urban and peri-urban development relates to the interventions and actions taken to manage, transform, and improve the areas in and around towns and cities. This includes physical infrastructure, service delivery, social infrastructure, economic activity, education, and the biophysical environment. Thus far, there have been numerous efforts to address the growing list of issues facing those living in urban and peri-urban areas. While many efforts seem promising, the majority fail to have a sustainable influence on people and their lives. Rapid urbanization, particularly in the Global South, along with growing urban inequality, calls for new approaches to development. There is increasing concern about the influence of a changing climate in cities and their surroundings and the significant greenhouse gas emissions emitted from urban areas globally. Extreme weather events and insufficient mitigation and adaptation measures for climate change are significant concerns for urbanites, given their increasing likelihood and potential catastrophic impact – particularly in areas with high population density. According to UN Habitat, urban areas account for approximately "75 per cent of global primary energy and emit between 50 and 60 per cent of the world's total greenhouse gases" (UN Habitat 2023), primarily due to concentrated economic activities, industries, transportation systems, and buildings. With ongoing urban and peri-urban development, the demand for energy in urban areas is projected to rise, underscoring the importance of sustainable urban planning. In 2018, 55 percent of the world's population resided in urban areas, and this number is predicted to reach 68 percent by 2050 (United Nations Department of Economic and Social Affairs/Population Division 2018: 1). Hence, there is a pressing need to develop sustainable solutions to facilitate the transformation of urban and peri-urban development. As urbanization continues to accelerate, it is crucial to simultaneously address the environmental, social, and economic challenges associated with urban growth. Sustainable urban planning and development practices can promote resource efficiency, reduce greenhouse gas emissions, enhance resilience to climate change impacts, and improve the overall quality of life for urban dwellers. This includes adopting green building standards, promoting renewable energy sources, investing in efficient public transportation systems, prioritizing walkability, developing cycling infrastructures, implementing effective waste management strategies, and fostering community engagement. By integrating sustainability into urban and peri-urban development, we can create healthier, more livable, and environmentally friendly cities that meet the needs of present and future generations. Our discussions touched upon all these issues and resulted in the following four ideas for sustainable urban and peri-urban transformation.

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Based in Cape Town, South Africa, Lavinia is pursuing her PhD in Ecology. Her research is focused on understanding and identifying the ways in which major infrastructure developments will influence natural landscapes across sub-Saharan Africa. Lavinia is also an experienced research facilitator and Design Thinking coach working with transdisciplinary organizations and multidisciplinary teams to turn ideas into actions that address societal needs.

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a. Normalizing self-reliant farming systems in urban areas

Description

Food security is a top concern of modern society. The COVID-19 pandemic has exposed the fragility of the global food system, leading to food shortages and disruptions in supply chains. This has spurred interest in developing self-reliant food systems in urban areas (Valley & Wittman 2019). The idea of self-reliant food systems is not new (Türker & Akten 2022), but the pandemic has highlighted the importance of ensuring food security in urban areas. There are competing demands for localization of food production within a city especially in terms of land availability (Jensen & Orfila 2021). Therefore, it is observed that many agricultural and farmlands are located outside of the city in the rural regions. This reliance makes urban populations vulnerable to disruptions in the food supply chain (Lal 2020), such as those caused by the pandemic, war, and drought seasons. One approach to achieving self-reliance in food supply is urban farming (Grewal & Grewal 2012), where individuals and communities cultivate their own food in available land, including abandoned areas, or through vertical farming techniques in places where urban land is scarce (Ayambire et al. 2019). Urban farming can take many forms, including rooftop gardens, community gardens, and vertical farms. These types of farming can provide fresh and nutritious food while reducing the carbon footprint of food production by minimizing transportation and packaging costs.

Urban farming not only addresses food availability issues, but also promotes ecological sustainability, reduces greenhouse gas emissions, and supports the livelihoods of urban communities. Other benefits of urban farming, beyond food security, include: improving air quality (Orsini et al. 2014), reducing the urban heat island effect (Lucertini and Di Giustino 2021), and expanding urban habitats for biodiversity (Orsini et al. 2014). Moreover, urban farming can provide economic benefits by creating job opportunities and supporting local businesses. There are various ways in which the four levers influence the adoption of urban farming systems. For example, under the Economy and finance lever, providing financial incentives to individuals and communities to establish urban farms is critical for promoting self-reliant food systems. One implementation mechanism could be local governments offering tax reductions to investorts that invest in urban farming. Additionally, microfinance programs can provide loans to support the establishment and maintenance of small-scale urban farms. From a Science and technology perspective, innovations in technology, such as hydroponics, aquaponics, and vertical farming, can make urban farming more efficient and productive. More

research can provide insight into the most effective ways to establish and maintain urban farms, especially with the advance in artificial intelligence, machine learning, and internet of things. Social scientific research can likewise provide insight into best practices and gather and record experiences from urban farming experiments across the globe. Individual and collective action is critical in promoting self-reliant food systems. Individuals and communities can contribute to sustainable urban transformations by establishing and maintaining urban farms, sharing knowledge and skills, and supporting local businesses that promote and utilize sustainable food systems. Collective action can take many forms, including the formation of community gardens, the establishment of farmers' markets, and the creation of urban farming cooperatives.

Context and application

The application of urban farming is context-dependent, and factors such as available land, climate, and community acceptance influence its success. Successful implementation requires a multi-stakeholder approach that builds on collaboration between policymakers, researchers, and local communities. It is also foreseen that the integration of technology and innovative techniques, such as hydroponics and vertical farming, can help overcome the constraints of limited space in urban areas and would result in a higher adoption of urban farming practices. The idea of urban farming can vary in terms of scale. This is mainly related to land use planning or the available land. For example, residents staying in landed properties can make use of their yards for farming purposes. On the other hand, residents staying in high-rise buildings might not have the same opportunity. In this manner, common shared space such as neighborhood gardens or rooftop areas can make up for that lack of private space for farming. The key is to optimize the available land to grow edible foods, thus creating self-reliance in case of another disruption in the global food supply chain. In general, urban farming has the potential to improve local food security, reduce greenhouse gas emissions, and promote a sustainable and resilient food system in urban areas across the world.

Relevant actors

The relevant actors for the implementation of self-reliant food systems in urban areas are diverse and include policymakers, urban planners, farmers, community organizations, and residents (Vitiello and Wolf-Powers 2014). Policymakers can create policies and regulations that support the development of urban agriculture, such as providing tax incentives, creating zoning regulations for urban farming, and supporting community-gardening initiatives. Urban planners can incorporate food production into their designs for new urban developments and for retrofitting existing ones. Farmers can grow a variety of crops and raise livestock in urban areas by use of innovative techniques such as vertical farming and aquaponics (Carter 2003).

Community organizations can provide education and training on sustainable farming practices and support the development of community gardens. Residents can grow their own food in backyard gardens or on balconies, participate in community-gardening projects, and support local farmers through purchasing locally grown produce. Climate, soil, and water availability play a crucial role in terms of ensuring that the farming can provide healthy outputs. This emphasizes the role of science and technology to ensure optimized farming systems that will withstand the challenges of unpredictable and changing environmental and climatic factors.

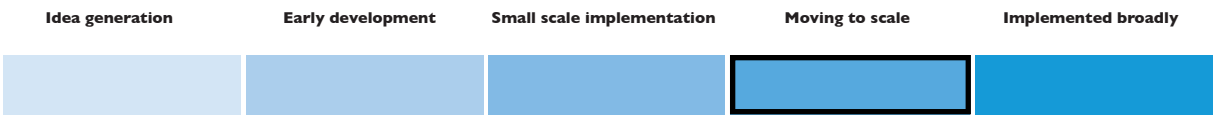
Implementation strategy

The implementation of urban farming requires a collaborative effort among various stakeholders such as government, local communities, and private-sector actors. It is essential to have the right policies in place that incentivize urban farming and facilitate the process of acquiring land for farming purposes (Chodavadia, Zatman, and Goodwin 2021). Developing community gardens, rooftop gardens, and vertical farms can also help promote urban farming. Technological advancements such as hydroponic farming and smart farming can make the process of urban farming more efficient and productive. Moreover, providing education and training programs to individuals and communities on the benefits and techniques of urban farming can increase awareness and promote the adoption of this practice. Lastly, there needs to be a shift in the societal mindset toward viewing urban farming as a viable solution to addressing food insecurity and promoting sustainable agriculture.

Challenges and barriers

Urban farming, although promising, faces several challenges and barriers that limit its implementation and scalability (Van Delden et al. 2021). First, urban areas are often characterized by limited access to land, especially in low-income neighborhoods where green spaces are scarce. Moreover, urban agriculture is often associated with inadequate soil quality, contamination, and limited access to water and other resources. The lack of access to resources can limit the production and diversity of crops and decrease the sustainability of urban farming. Additionally, social and cultural norms often favor ornamental landscaping over food production, and policymakers may not prioritize urban farming in their agendas. The limited access to financial resources, technical expertise, and education can also hinder the growth and development of urban farming projects (Wadumestrige Dona, Mohan, and Fukushi 2021).

Maturity status



The maturity level of urban farming initiatives varies greatly from one place to another, depending on the local context and the level of stakeholder involvement. Successful implementation of urban farming is dependent on factors such as policy, funding, infrastructure, education, and community involvement (Wadumestrige Dona, Mohan, and Fukushi 2021). Cultural norms and attitudes toward urban agriculture may play a role in the adoption and promotion of urban farming (Orsini et al. 2013). While the concept of urban farming has gained popularity in recent years, particularly in response to food security concerns during the COVID-19 pandemic and warfare, which affected global food supply chains, there is still a lack of widespread knowledge and expertise in implementing and scaling up urban farming initiatives. To optimize the benefits of urban farming and balance human needs with ecological sustainability, a multi-stakeholder approach is necessary - involving policymakers, researchers, local communities, and other stakeholders.

Success criteria

The success of urban farming can be measured in various ways. Some of the criteria are:

1. The amount of food produced from urban farming reduces the dependence on imported food in cities.
2. Increase in the number of urban farming communities and initiatives.
3. Increase in urban farming markets.
4. Increase in urban farming job opportunities.

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b. An ecovillage-inspired model for peri-urban development

Description

While ecovillages are typically implemented in rural settings (Dias et al. 2017), our group highlighted how they also offer a transformative way forward for peri-urban development, if established in an inclusive and sustainable way. According to the Global Ecovillage Network (2020), an ecovillage is defined as an "intentional, traditional, or urban community, that is consciously designed through locally owned participatory processes in all four dimensions of sustainability (social, culture, ecology, and economy) to regenerate social and natural environments." Here, we propose the adoption of an ecovillage-inspired model in peri-urban settings where requirements for physical space and natural resources can be met. Urban and peri-urban areas across the world are experiencing rapid expansion, often followed by growing inequality (Babiker et al. 2022, Mahendra et al. 2021, Bartlett, Mitlin, and Satterthwaite 2013). There is thus a need to meet the growing demands that accompany this rising urbanization (UN Habitat 2022, Government of South Africa 2022). Given the ecological impact of urban expansion (IPBES 2018), actions should be implemented in a way that contributes to natural preservation and regeneration, specifically through the maintenance of natural cover, including provisions of ecosystems services such as carbon storage, and with due consideration to amenity values, religious values, and the raw materials harvested (Turpie et al. 2017). Our idea is to use the principles of a traditional ecovillage to inspire a new peri-urban ecovillage model that can address rapid urbanization and inequality while promoting a more sustainable lifestyle. As ecovillages arise in rural areas where legal and economic barriers are reduced (Kasper 2008, Ergas 2010, Litfin 2014), an ecovillage within a peri-urban context will differ from that of an isolated rural context, hence the need for an adaptation – an ecovillage-inspired model.

Ecovillage is not a new concept; it has been implemented in many different contexts around the world. While they may look and feel different, in essence, an ecovillage is based on the idea of human development in harmony with nature (Venkitaraman and Joshi 2022). Many scholars have viewed an ecovillage as a bottom-up grassroots initiative. However, there seems to be a shift in the understanding of its ideal implementation. Gausset (Forthcoming) presents two avenues through which an ecovillage can be implemented based on his work in Denmark. The first avenue is to create new communities built from the top down with municipal support. The second avenue is to establish the ecovillage through a bottom-up, community-led

approach. We propose to situate the ecovillage-inspired model somewhere in between these two avenues, based on principles of collaboration on different administrative and practical levels. In line with the principles of sustainability, the area should be able to support ecological processes and offer ecosystem goods and services. An ecovillage within a peri-urban setting requires physical land and the maintenance of a certain Building Coverage Ratio (BCR) (alternatively a Green Coverage Coefficient). In addition to ecological requirements, the model should incorporate the element of climate vulnerability to ensure that actions are well informed. In terms of social and economic concerns, the ecovillage-inspired model is supposed to support people, cover their basic needs, offer affordable housing options, provide access to economic and social opportunities, and provide access to transport infrastructure networks. Consequently, this idea is based on the assumption that a well-functioning ecovillage will accommodate various interests of both people and environment (Gausset forthcoming). In contrast to a typical development approach in urban or peri-urban contexts, the ecovillage-inspired model builds on principles of inclusiveness and direct user participation in the design, creation, and monitoring processes related to the ecovillage. The model will also address core systemic design elements by considering: 1) Who needs to be involved? 2) Where does this fit? 3) How will this be approached? 4) What is required to achieve this? (Block 2021). Implementation of an ecovillage-inspired model in peri-urban areas requires a rethinking of existing governance structures and decision-making processes. Furthermore, transdisciplinary research is required to develop the model beyond the traditional ecovillage concept – specifically to identify the different pathways through which an ecovillage may emerge, its likelihood of success, and associated risks. In general, the feasibility of different options requires more data, and further research is needed to understand the long-term impacts of ecovillages on the wider socio-ecological system.

Context and application

All actions, starting from conception through to the implementation of an ecovillage, should be guided by principles of sustainability, inclusive collaboration, and climate resilient development. This includes recognizing complexity, equalizing power, and creating a space for adaptive learning (Babiker et al. 2022, Government of South Africa 2022, Block 2021, Victoria State Government 2019, Alberta CoLab 2016). Through this guidance, the ecovillage-inspired model offers an opportunity to adopt a sustainable lifestyle, maintain ecological integrity, increase resilience to climate change impacts, and address rapid urbanization and inequality. The objective of each ecovillage is expected to depend on several factors, especially since the ecovillage is centered around the needs and shared interests of a given community. Its application in peri-urban areas, particularly in the Global South, requires: the availability of physical space (i.e. natural land or land with restoration potential), affordable housing

options, access (via reliable transport) to socio-economic opportunities and basic services (usually within the urban zone), incentives and opportunities for sustainable innovation and business, commitment and buy-in from both residents and local authorities, and finally a participatory creative design process where all members of a community are invested. The model must adopt a participatory approach, as active inputs from all relevant actors are crucial for the ecovillage's ability to address the actual needs of its residents and be sustainable (Victoria State Government 2019). The way in which the ecovillage will address the needs of its residents should (ideally) integrate elements of a traditional ecovillage and add new elements to deal with the existing challenges within peri-urban contexts.

Relevant actors

A successful implementation of the ecovillage-inspired model requires a consideration of the following factors: the natural environment, water, energy, community and culture, economy, local food systems, building and design, and education (Thierfelder 2020). Human actors of relevance to the establishment and functioning of an ecovillage include: a governing board, advisory board, residents, people from surrounding areas, local government, donors, developers and builders, housing organizations, partners (e.g. the UN or the Global Ecovillage Network), NGOs and civil society bodies, researchers, facilitators, service providers (for e.g. health, food, energy), and business development consultants. Local NGOs and civil society organizations are key to co-facilitating this process.

Implementation strategy

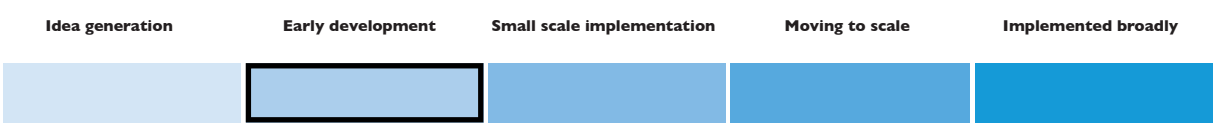
The ecovillage-inspired model can act as a framework for action within peri-urban contexts, because the guiding principles and goals of the model involve a process with collaborative and coordinated practices. Implementing the model implies a process that starts with dialog and conversation between affected residents and other actors. If an agreement is made, the process can proceed and transformation into an ecovillage-inspired lifestyle can begin. The practices adopted, and actions taken, should be aligned with the principles and goals of the ecovillage-inspired model. Support from entities engaged with urban planning and policy, governance, financing, and innovation and technology should be in place to promote such systemic transformation (Babiker et al. 2022). Additional groundwork is required to foster an environment for collaboration between potential residents, local municipalities, and other relevant actors. The ecovillage-inspired model should be presented and clearly communicated between the community, government (local authorities), practitioners, and all other relevant actors. This is important because an ecovillage will bring changes to local institutions and authorities, requiring coordination and cooperation – whether or not it is based on a top-down

or bottom-up approach (Babiker et al. 2022, Wolfram 2016). Consequently, ecovillages will have to align with existing regulations, and given their requirements and practices, new regulations will need to be developed (Global Ecovillage Network 2022). Certain local municipal divisions, dedicated to sustainable development and building resilience (e.g. the Sustainable and Resilient City Initiatives Unit at the Ethekwini Municipality in South Africa), are good candidates for initiating this process. Once commitment has been established, the vision for the ecovillage should be constructed in a democratic way using a community-based governance system. The following activities may be required in the initial stages of this idea: dialog between relevant actors, an assessment of the needs of the community, an ecological status assessment, a socio-economic status assessment, a climate vulnerability assessment, and the establishment of a clear motivation and intention. When these foundational elements of the proposed ecovillage-inspired model have been discussed, a proposal for implementation can be developed.

Challenges and barriers

Potential challenges may arise during different stages of implementation, most notably in the early stages of refining the ecovillage-inspired model. Current urban planning practices, particularly municipality-led ones, do not sufficiently engage with residents. On the other hand, when residents do engage, consensual decision-making is not always straightforward and can take time (Venkitaraman and Joshi 2022). In general, there is a lack of specific regulations for developing an ecovillage which can cause tensions among implicated actors. To explain, it is possible that the ecovillage will be used in relocation efforts to move people out of unsafe areas, particularly those facing climate risk. It is also likely that ecovillages act as settlements for those looking to move to urban areas. Hence, this process should be conducted in an ethical manner with transparency and due consideration to the marginalized position that certain implicated people may inhabit. Other challenges have to do with the aftermath of the implementation. As an example, an ecovillage that grows in size is likely to become more complex and difficult to govern (Venkitaraman and Joshi 2022). Likewise, established ecovillages can lead to displacement or exclusion over time, especially since some ecovillages in the Global North, sometimes referred to as intentional community experiments, are exclusive to groups of people that have similar socio-economic characteristics (Dias et al. 2017).

Maturity



The idea of developing new ecovillage-inspired settlements in urban peripheries, as a response to rapid urbanization and inequality, is still in the early idea development stage. However, ecovillages are not new, but exist in different forms across the world, making it a matter of geographic location to determine the maturity of the idea. While more intentional ecovillages have been developed, especially in the Global North, there is less evidence of ecovillages acting as tools to address social, economic, and environmental distress in the Global South.

Success criteria

The success of the ecovillage-inspired model is dependent on both its goals and its ability to meet the needs of its residents. Thus, the following factors can be assessed:

- Level of life satisfaction and well-being among ecovillagers
- Carbon footprint reductions
- Waste reductions
- Number of ecovillagers
- Living expenses
- Biodiversity
- Extent of natural land cover within the ecovillage
- Provision of ecosystem goods and services

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c. Optimizing ecological benefits in urban areas through efficient land use planning

Description

With urban areas around the globe expanding at an exponential rate, it is important to ensure that these areas will be future-proof and climate resilient. This invites a highly debated topic, namely, land sharing versus land sparing in urban(izing) areas. Optimizing the ecosystem services is a critical aspect of sustainable development, especially in urban areas where lands are scarce (Tzoulas et al. 2007). In this regard, effective land use planning is important to strike a balance between economic development and ecological sustainability.

Land sharing involves integrating agricultural or other land use practices within natural ecosystems with an aim to maximize ecological benefits. These ecological benefits include biodiversity conservation and diverse ecosystem benefits such as reducing the urban heat island effect, regulating air pollution levels, and purification of water sources. At the same time, this approach also ensures that the demand for food and other resources for human populations is met (Fischer et al. 2014). For example, agroforestry is a land sharing approach that integrates trees with crops to increase soil fertility and provide additional ecosystem services such as carbon sequestration, erosion control, and water conservation.

On the other hand, land sparing involves separating areas for conservation and areas for intensive human land use. This approach seeks to maximize ecological benefits in protected areas while meeting human needs through intensive land use in other areas (Fischer et al. 2014). Land sparing aims to minimize the negative impacts of human land use on the environment, while ensuring food and other resources for human populations. For example, protected areas such as national parks are examples of land sparing initiatives, where areas of high ecological value are set aside for conservation, and intensive human land use is prohibited. If done holistically, these two (seemingly contradictory) approaches can together maximize the ecological benefits they provide to both the environment and society. Optimizing ecosystem services for ecological benefits requires a balance between human needs and environmental sustainability. However, the effectiveness of different approaches varies in different contexts, and a combination of both land sparing and sharing may be necessary in some cases. Besides striking a balance between sparing and sharing, the effectiveness of this approach is also largely influenced by the four levers mentioned in the introduction, namely: Governance, Economy and finance, Science and technology, and Individual and Collective Action. These levers have different implications for the outcomes of land sharing and

land sparing approaches. For example, in terms of Economy and finance, land sparing may require large investments in protected areas and conservation programs, while land sharing may require investments in sustainable agricultural practices and ecotourism. In terms of Science and technology, research may be needed to develop sustainable agricultural practices that can be integrated with natural ecosystems in land sharing scenarios, while research on protected area management may be needed for land sparing. Likewise, it is important to make a science-based determination of the best ecosystem services for a given area, with due consideration to both social and environmental particularities of a given locality. Individual and collective action may involve educating local communities on the benefits of ecosystem services and sustainable land use practices, while policies may need to be developed to promote and determine land sharing and land sparing approaches, such as providing incentives for sustainable agricultural practices or designating protected areas.

Context and application

Land sharing and land sparing are globally applicable approaches, but their local implementation requires in-depth research. An example of urban land sharing through nature-based solutions is green roofs which counteract the impact from densification in urban areas. In the UK, green roofs are designed to manage storm water locally, mimicking natural drainage and encouraging sustainable drainage systems (Worrall and Little 2010). Although the implementation of such solutions is context-specific, there are universal lessons that can be applied in other contexts. Therefore, the successful implementation of land sharing and land sparing strategies requires a context-specific approach that considers the unique characteristics and challenges of each local environment, and which draws on previous experiences from across the world. Furthermore, research and innovation are crucial to developing and implementing nature-based solutions that can optimize ecosystem services for ecological benefits while meeting the diverse needs of local communities.

Relevant actors

Urban communities, ranging from individuals to broader structures of governance, play a crucial role in improving urban ecosystems to promote ecological benefits that can enhance the health and well-being of human and non-human urbanites. Enhancing the urban ecosystem can lead to various ecological benefits, such as improved water quality, reduced urban heat island effect, and provision of habitats for biodiversity. However, optimizing ecosystem services for ecological benefits faces several challenges, including balancing land sharing and land sparing (Haase and Nuissl 2010, Geschke et al. 2018), limited resources and investment, a lack of understanding and awareness of ecosystem services among policymakers, and disorganized

collective action among the public. Overcoming these challenges requires a multi-stakeholder approach that involves policymakers, researchers, local communities, and other stakeholders that altogether work to balance human needs with ecological sustainability.

Implementation strategy

Implementation strategies for optimizing ecosystem services in urban areas require a multifaceted approach that involves stakeholder engagement, policy changes, and technological advancements (Kennedy et al. 2013). Stakeholders, including policymakers, investors, and the public, need to be made aware of the importance of ecosystem services in urban areas and the ecological benefits they can provide. Policies that prioritize the enhancement of urban ecosystem services and provide incentives for their implementation need to be developed. Technological advancements, such as the development of green infrastructure, can also play a significant role in optimizing ecosystem services in urban areas (Tzoulas et al. 2007). Furthermore, community involvement in the planning and implementation of ecosystem service projects can lead to increased support and success. Overall, a collaborative approach that involves multiple stakeholders and utilizes a variety of strategies is necessary for effectively optimizing ecosystem services in urban areas. This includes a combination of sparing and sharing urban areas.

Challenges and barriers

The idea of optimizing ecosystem services for ecological benefits in urban areas is hindered by a lack of comprehensive understanding of the complexity of urban ecosystem services and their ecological benefits (Childers et al. 2014). Urban ecosystems are multifaceted and consist of various components that interact with each other in complex ways – the changes of which may take years to manifest. This complexity makes it difficult to demonstrate the benefits of enhancing urban ecosystem services to stakeholders, including policymakers, investors, and the public. It is also important to note that there is a lack of understanding of various methodologies used to evaluate ecosystem benefits. The lack of such information makes it difficult for stakeholders to make informed and evidence-based decisions. As a result, there are often scarce budget allocations for improving urban ecosystem services. For example, implementing nature-based solutions to optimize urban ecosystem services, such as green roofs or urban forests, may require significant investment and may not provide immediate, tangible benefits that can be easily measured or understood by stakeholders (Escobedo, Kroeger, and Wagner 2011). Therefore, raising awareness of the importance of urban ecosystem services and their ecological benefits, and demonstrating their long-term value to stakeholders, is essential to obtaining adequate funding and support for implementing initiatives to optimize urban ecosystem services.

Maturity

The maturity degree of optimizing ecosystem services in urban areas varies depending on geographic context. Cultural norms, beliefs, and community attitudes may impact the adoption and promotion of urban ecosystem enhancement. A main challenge is a lack of knowledge and expertise for local implementation. Despite the challenges that arise from this idea, the concept of enhancing urban ecosystem functions is gaining recognition on a global scale. This is evident in the increase in research on adopting nature-based solutions in urban areas to tackle climate-related issues such as flash flood, urban heat island effect, and poor air quality (see e.g. Bayulken, Huisingh, and Fisher 2021, García-Blanco, Navarro, and Feliu 2023).

Success criteria

There are several ways to measure the success of this idea. The ecological benefit of optimizing ecosystem services in urban areas can be measured through environmental, social, and economic factors (Gómez-Baggethun et al. 2010).

1. Environmental success can be measured by the improvement in ecological services such as water and air quality, the reduction of urban heat, and increases in urban biodiversity. This information can be obtained through continuous monitoring of the ecosystem.

2. Social success includes improvement in the health and well-being of urban residents and increased awareness of, and engagement in, ecosystem service projects.

3. Economic success can be measured by the return on investment in ecosystem service projects and reduced costs associated with the optimizing of ecosystem services. For example, a study from Kwan et al. (2023) has simulated the reduction in respiratory mortality due to polluted air based on a net reduction of carbon emissions in Malaysia.

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d. The sustainable-neighborhood initiative

Description

Our group discussions revealed the need for a tool to coordinate neighborhood action toward sustainable development. We named this the sustainable-neighborhood initiative (SNI), which is a framework for addressing spatial inequality in urban and peri-urban settlements, specifically in places where living conditions are unsuitable and undignified. The SNI is a living framework that is likely to emerge in different ways. That said, our working group formulated three phases, each with guiding principles to enable a gradual transition toward a suitable and sustainable living settlement. Indeed, there are several existing initiatives that play a critical, but often isolated role in addressing sustainability. Urban challenges are intertwined (Babiker et al. 2022, UN Habitat 2022) and require solutions that adopt a systemic lens. Interventions are required to deal with connections and interactions that exist across space and time (International Science Council 2023). Yet, the growing investment in development work within the Global South has resulted in numerous projects running concurrently, and often there is an overlap in what is done and a lack of integrated approaches.

The SNI framework aims to guide a collaborative process, coordinating community activities from concept through to implementation. The idea of the SNI builds on previous and existing interventions toward community-driven change in urban areas, but takes a more holistic approach, enabling the systemic design of a sustainable neighborhood through community involvement. The following underlying principles and goals act as a foundation for the SNI framework: The first phase focuses on building relationships between different actors, creating the conditions for collaboration and creation. This includes agreeing on and clearly communicating the goals of the SNI. The goals are made with the intention of ensuring that people have access to (1) basic services, (2) decent and affordable housing, (3) nature, (4) social and economic opportunities, (5) communal physical and human resources for continuous learning and innovation, and (6) a reliable transport system connecting them and their neighborhood to the wider urban network. In the second phase, access is addressed and the actions toward a sustainable neighborhood are planned and agreed upon. The process is to be democratic, and the actions should align with the underlying principles of sustainability, which includes considering climate risk and vulnerability. The third phase is to move from planning to community agency and ownership through the implementation of agreed upon neighborhood-driven initiatives. Additional transdisciplinary research efforts are required to inform practices and processes necessary for adopting the SNI. Mission-driven research efforts are necessary to take stock of the different development interventions within a given urban and peri-urban context.

Such research offers a better starting point for both practitioners and other actors who aim to make use of frameworks like SNI to identify suitable models for different neighborhoods.

Context and application

The SNI framework is especially useful in the Global South where urban inequality is severe (Bartlett, Mitlin, and Satterthwaite 2013, Nijman and Wei 2020, Ziervogel et al. 2017) and where residents have unequal access to basic services and socio-economic opportunities. Its use in existing dense and growing informal townships and settlements will enable communities and local municipalities to co-design a place based on the needs of people and the resources available. In general, the SNI has the potential to solve problems that were not solved in the past, by focusing on a neighborhood scale and working with the specificity of each neighborhood. In this way, the SNI acts as a mechanism for understanding what people need to thrive in the place they live. Thus, the social, cultural, economic, and biophysical contexts of the neighborhood will inform the SNI process. In this regard, a measure of inequality, including social and economic distress such as a "neighborhood distress score" (Jennings 2012), is key to identifying neighborhoods that are likely to benefit from the SNI framework. The aim is to implement the SNI framework within urban contexts that have existing solid structures and systems in place. Furthermore, the initiative must be based on a long-term perspective and should encourage sustainable human-nature connections, innovation, and agency. The initiative may be municipality-led, although it will need input from all implicated actors, as a locally led municipal approach in partnership with affected communities increases the likelihood of success (Victoria State Government 2019). Existing municipal divisions that share a vision to increase sustainability and build resilience can act as initial hosts for the SNI. Other suitable candidates for facilitating the SNI are NGOs with proven experience in mobilizing and facilitating engagements that promote just societies. Research on the success of such collaborative processes includes Appadurai's (2019) work with Slum Dwellers International or Larsen's (2022) work with the Namibian art and activist collective Decolonising Space, during their co-creation of open public spaces across Namibia's informal settlements.

Relevant actors

Given the holistic nature of the SNI, all elements of society should be considered. A participatory approach should engage municipalities, residents, urban planners and designers, biodiversity and ecosystem experts, social scientists, facilitators and mentors, businesses, housing developers, donors, and potential private-sector investors. Non-governmental organizations and civil society bodies, particularly those involved in grassroots work, are likely to play a significant role in identifying the relevant actors within a given neighborhood.

Implementation strategy

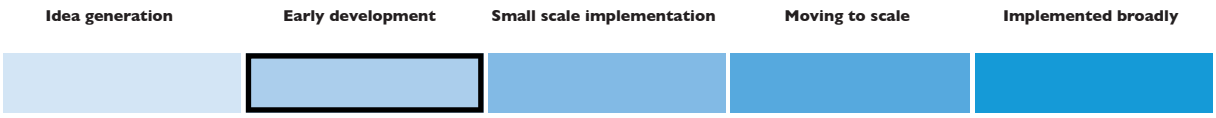
Implementation of the SNI should be tailored to local needs and incorporate fundamental principles of sustainability. The vision for the neighborhood should be designed through a participatory and inclusive approach, incorporating guidelines for best practice (such as C40 Cities 2019, Oscilowicz et al. 2021) that align with the goals of the SNI. In the first phase, there is an emphasis on the conditions that enable successful collaboration and co-creation, specifically through building relationships between relevant actors, including a shared understanding of the SNI's principles and goals. Assessment of needs and access is key to developing this idea, as it will provide clarity in regard to the neighborhood's patterns and resources (for e.g. mobility, consumption, production, physical and social infrastructure, and ecology). In the second phase, residents should be engaged to co-create the vision for their neighborhood. The various opportunities, and actions needed, should be identified, following an assessment of their feasibility within the context of each neighborhood. Finally, a plan for transitioning toward a suitable and sustainable neighborhood must be developed. In the third phase, actions should be initiated with ongoing efforts to monitor, engage, and align. Ultimately, the SNI should foster sustainable innovation, promote self-sufficient practices, facilitate agency, and enable transformation on a neighborhood level. There are other key requirements that relate more indirectly to implementing the SNI. For example, governance structures are key to developing regulations and policies that enable action. However, implementing an SNI also warrants the involvement of non-governmental organizations and civil society to increase the capacity to co-create, coordinate, and integrate plans within each neighborhood. Another dimension of this idea relates to financing, specifically its availability and accessibility. The SNI requires the mobilization of development finance and potentially new business models that encourage bottom-up action. Finally, the issue of access to land and securing tenure will be critical for addressing land rights.

Challenges and barriers

A main challenge that hinders the broadening of SNIs is that local governance often appears unable to effectively address urban inequality in the Global South. The idea of an SNI requires a division dedicated to addressing access in specific neighborhoods. Weak and corrupt governance, resulting from lacking transparency and commitment, threatens the success of this idea. Thus, local governments will need resources and willingness to work with a range of actors to create the necessary conditions to enable transformation (Mahendra et al. 2021).Another challenge concerns the collection of information during the different phases, which risks becoming a data product that provides important information in exchange for monetary gain and marketing strategies or surveillance purposes. To combat this, we recommend support mechanisms to guide SNIs in terms of data and user protection, and urge

all implementing parties to adhere to national and international data protection regulations. Determining how to address access can be a barrier too. People have different needs and interests, making it difficult to accommodate the wishes of all residents. Spaces and activities may be developed to meet different needs, and reliable transport systems must be in place to ensure easy access to services and opportunities outside the neighborhood. Lastly, there is a risk of displacement and gentrification, when greening underpins growth and development (Anguelovski et al. 2019, Oscilowicz et al. 2021). Thus, tools such as anti-displacement policies or community-focused financial schemes aimed at homeowners and renters should be put in place to safeguard all inhabitants of a given neighborhood (Oscilowicz et al. 2021).

Maturity



The framework of an SNI, as explored in this idea, resonates with many existing projects that provide a flexible and simple framework for community action and collaboration. Overall, there is a calling for holistic interventions that address multiple challenges in a sustainable way. A growing number of non-governmental organizations and researchers are working to tackle urban issues, such as CDKN, UN Habitat, C40 Cities, ICLIE Africa, Slum Dwellers International, African Centre for Cities, and the African Climate & Development Initiative. Presumably, due to the nature of inequality within urban and peri-urban settlements, researchers and practitioners have realized the need for approaches that are both participatory and inclusive (UN Habitat 2022, Taylor et al. 2021, C40 Cities 2019, Ziervogel et al. 2017, Taylor, Cartwright, and Sutherland 2014).

Other interventions relate to nature within urban and peri-urban environments, such as Public Urban Green Spaces (PUGS) and projects supporting nature-based solutions (Vidal et al. 2022). Additionally, the SNI draws inspiration from new strategies like the New Urban Agenda or the recent model for implementing mission science for sustainability (International Science Council 2023). Furthermore, the City of St. Louis' Sustainable Neighborhood Initiative shares certain goals with our proposed SNI framework and has useful tools that can be adopted in the implementation of this idea (City of St. Louis 2013).

Success criteria

- Active participation by residents
- Level of commitment from different actors
- Resident access to services, nature, and opportunities
- Resident satisfaction and well-being
- Number of communal spaces and their use
- Financial investment in neighborhood

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ENTRY POINT 6

Global environmental commons

Global environmental commons refer to resources that are necessary for maintaining the healthy ecosystems and human well-being, and which fall outside the national jurisdiction of a single country or entity. The high seas, the deep sea, the atmosphere, the outer space, and Antarctica, are all perceived as global environmental commons. However, the discussions on sustainable development and environmental protection have included other commons that may ordinarily lie within national jurisdictions, but which position themselves beyond these jurisdictions because they provide global benefits. These include freshwater bodies, forests, transboundary national parks, and transboundary lakes and biodiversity hotspots that transcend national boundaries and impact the entire planet. Protecting the resources that constitute our global environmental commons is crucial to maintaining and improving the balance between nature and humanity – and averting many challenges at both local and global scales. At present, the challenges facing the global environmental commons are complex and multifaceted, affecting human health and biodiversity in various ways. These challenges range from climate change and biodiversity loss to environmental pollution and degradation of ecosystems. Addressing these challenges requires both global perspectives and collaborative efforts. In our group discussions, we defined transformations within global environmental commons as action or research that can be undertaken to address the listed challenges to long-term sustainability. During the discussions, participants echoed that the fate of our planet depends on our ability to protect and restore the global environmental commons. The skills and abilities to combat these challenges can be achieved when countries, organizations, and communities work together to develop sustainable practices, policies, and technologies that not only protect, but restore the global environmental commons. Consequently, we urgently need a shift in how we perceive and manage common resources, moving away from exploitation and toward stewardship and equitable use.

During the Transformation Labs process, we explored and identified three ideas that, if implemented, will help to bring transformative change, fast-track sustainable development, and secure the global environmental commons. These ideas are a product of transdisciplinary discussions by participants from different research disciplines and geographic contexts whose multiple viewpoints enrichened the outcomes of the discussions. However, considering that environmental conservation is usually geographical and context-specific, the outcomes of these discussions may also reflect certain implementation limitations when applied to different contexts. We therefore emphasize the crucial role of international cooperation, policy framework transformation, technological advancements, public awareness, and inclusion as keys to managing our global environmental commons in favor of our entire planetary system.

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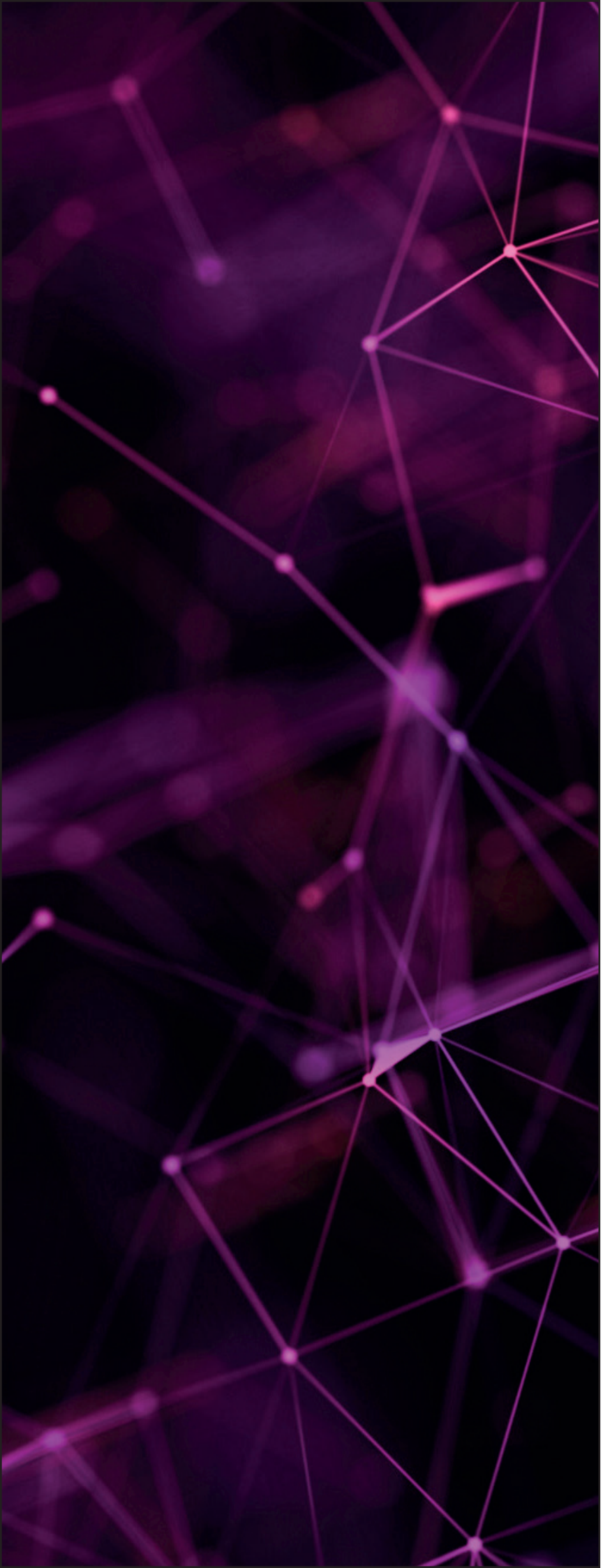

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a. Identification of DNA barcodes from endemic and key species to enable biodiversity monitoring

Description

There is a global desire to conserve and monitor biodiversity. This has most recently been expressed in the Kunming-Montreal Global Biodiversity Framework (GBF) 2022 (Convention on Biological Diversity 2022). However, this framework faces a major task, as the present status of life and biodiversity in the ocean and on land is largely unknown. Nature is a truly circular economy where energy and elements combine to create myriads of large and magnificent organisms. Following this production phase, organisms are again broken down to their constituent parts – usually by very small organisms – and the process of production can begin once again. Because the organisms responsible for regenerating the constituent parts of living organisms are so small, their distribution and abundance is not well known. In recognition of this challenge the GBF stated that a key goal was to investigate the potential of using genetic resources to acquire biodiversity assessments. DNA is shared by all life-forms – like species-specific fingerprints – thus circumventing the need for visual species observation in order to monitor the organisms present. With every contact with the environment, DNA is released from an organism.

The group's discussion addressed the benefits of implementing environmental DNA (eDNA) databases for identifying and conserving the local biodiversity on land and in the ocean. Currently, the most popular approach for determining genetic diversity is eDNA metabarcoding. This can be done on solid (e.g. soil) samples or on material filtered from water. In this manner, DNA sequences from animals, insects, birds, fish, phytoplankton, fungi and bacteria, and many other taxonomic groups can be isolated in the absence of access to the biological source (Taberlet et al. 2012). Similar experiments have been conducted, aimed to capture airborne DNA on land (Bohmann and Lynggaard 2023). Using eDNA allows us to register and monitor existing biodiversity and follow key species (Thomsen and Willerslev 2015). eDNA sequencing is still relatively expensive and requires access to sophisticated laboratory equipment. However, it is a method that is developing quickly, with associated cost reductions. It is also a method that can offer enormous time savings, in that it potentially obviates the need for visual identification of species present. Thus, building (and improving existing) eDNA databases will help monitor biodiversity on a grand scale, which would not be possible without the use of DNA sequencing. That said, eDNA metabarcoding relies on specific potent sequences of the

DNA genome of a specific species. This means that the output of eDNA metabarcoding is only as good as the references available. The lack of references, also referred to as DNA barcodes (or fingerprints), for specific species goes for both above and below sea surface and is an even bigger issue when looking at smaller organisms (Davies, Field, and Genomic Observatories Network 2012, Mann and Vanormelingen 2013). Correct species identification is fundamental for all biological research, for conservation, and for management of biodiversity. Engaging and utilizing local efforts and experts is the key to obtaining, identifying, and harvesting DNA barcodes from endemic and key species of a given region. Margaryan et al. (2021) estimated the cost of obtaining DNA barcodes to be 25€ per specimen, making it a low-cost method ready to be implemented on a wide global scale. Finally, contributing to an open-access database of reference barcodes for local biodiversity has the potential of giving non-taxonomists a way to identify species and improve our understanding of biological diversity. This can become a goldmine of biological knowledge to students, teachers, government officials, and the public, and it can help make the world realize the need to protect and conserve our biodiversity.

Context and application

eDNA has the potential to reduce time and costs related to monitoring biodiversity, while increasing our knowledge on current (and past) biodiversity. eDNA can detect extensive amounts of taxonomic groups that have historically not been included in monitoring programs. The eDNA methods also offer several opportunities for standardization, reproducibility, and sample handling efficiency, making it an ideal tool for monitoring programs. Efforts to expand global DNA reference databases have already received great attention, and several databases are available, including: BOLD systems (BOLD Systems n.d.), the Earth Microbiome Project (Gilbert et al. 2010), TARA Oceans (Karsenti et al. 2011), and the Genomic Observatories (GO) Network (Davies, Field, and Genomic Observatories Network 2012). However, implementing this idea successfully involves strengthened regional and international coordination. This may also involve both financial and technical support to areas of the world where such needed resources for biodiversity monitoring and conservation are scarce or not available.

Relevant actors

eDNA should be included as a method in national environmental monitoring programs and be implemented through regional strategies in intergovernmental organizations that regulate or monitor the environment, such as HELCOM for the Baltic Sea, ICES for the North Atlantic, or the EU for European seas. It would be beneficial to establish international fora for sharing know-how, experiences, and resources related to eDNA capture and sequencing. Development agencies and programs should enable establishment of eDNA

reference databases in regions where biodiversity monitoring is currently limited. Knowledge of local biodiversity is to the benefit of the global public and ensures that the goals within the GBF can be met, thus signaling both a political and environmental victory.

Implementation strategy

The first step is to identify key species within a given region and obtain their DNA barcodes. The barcodes will be shared in major DNA databases and integrated in global biodiversity monitoring programs. Following this, a systematic monitoring program using eDNA can be designed. This entails the establishment of a regional monitoring network across relevant countries. The work of obtaining barcodes from key species could be shared within such a network and optimized by drawing on the knowledge of regional experts. Lastly, it is necessary to make provisions for establishing local expertise at national or regional levels across the globe. Accordingly, development and coordination of know-how on eDNA meta-barcoding must be facilitated to strengthen knowledge exchange and our understanding of the global interconnectedness of biodiversity and its monitoring.

Challenges and barriers

As eDNA is still an emerging and developing approach to biodiversity monitoring, know-how and experience are still being generated through small-scale experiments. The knowledge generated through these experiments needs to be thoroughly reviewed, processed, and systematized to harness the most informed and up-to-date foundation for the establishment of globally accessible eDNA databases. Likewise, given its emerging status, eDNA sequencing is still somewhat costly. That said, once the DNA databases are established, they will provide an effective tool to mass-scale global biodiversity monitoring with low long-term maintenance costs. Another current challenge to eDNA processing is the occurrence of bottlenecks within the work following sequencing. Moreover, a mass-scale eDNA database relies on regional and global collaborations, which rest on the collaborative abilities of scientists from different regions of the world and the support of relevant governing and funding bodies.

Maturity

Success criteria

One success criterion would be the establishment of a regional monitoring network across relevant countries. Within this network an agreement and implementation plan for systematic monitoring using eDNA should be made. The work of obtaining barcodes from key species could be shared between the participants within the network. Another success criterion would be continuous collection of eDNA, resulting in comparisons in biodiversity across time and space. This rests on the identification of key species across the world and obtaining their DNA barcodes. The barcodes should be shared in major DNA databases and be integrated in global biodiversity monitoring activities.

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b. Increasing transparency of value chains in relation to effects on biodiversity

Description

Export-oriented commodity trading has profound implications for the conservation and preservation of biodiversity in the Global South (Strassburg et al. 2017). Significant increases in production of commodities come from the conversion of native vegetation into agricultural lands (Hong et al. 2022). To limit the consequences of current value chains and instead make international trade a vehicle of positive change, it is necessary to (a) support geolocation-based mechanisms of transparency and (b) develop a scalable accounting system for land use and/or biomass conversion. These two elements comprise the following input on increasing biodiversity-related transparency of international value chains. In the new CBD Kunming-Montreal Global Biodiversity Framework, transparency of value chains, and specifically the requirement of companies to report on their biodiversity impact, plays a major role – primarily as targets 15 and 16 (CBD 2022). To this effect, a growing number of digital tools for assessing potential overall supply chain impact on humans and nature are currently being developed (Brooks et al. 2022). Despite increases in publicly available data, it is still difficult to trace the impact of individual products. For example, global customs information is coded into systems that do not indicate anything about the environmental credentials of the products that are being sent or received (West 2021). Therefore, increasing the transparency of value chains requires both that newer technologies such as remote-sensing and block chain are utilized, but also that public systems, in both exporting and importing countries, are reformed to take the new data into account.

When observing the current interplay between the Kunming-Montreal Global Biodiversity Framework, the 2030 Agenda for Sustainable Development, and the Paris Agreement, it is evident that global accounting for greenhouse gas (GHG) emissions must be accompanied by a similar accounting of biomass usage worldwide. Today, the gap between potential Net Primary Productivity (NPP) from the terrestrial biosphere and the actual NPP is significantly larger than it was three centuries ago due to the increased negative effects of global land use. In the year 1700, potential natural vegetation would have produced 56.2 gigatons of carbon per year (GtC yr-1), while land use resulted in the actual NPP being 54.7 GtC yr-1 – a gap equal to 1.5 GtC yr-1. By 2020, this land use-driven gap had increased to 5.6 GtC yr-1, as potential productivity would have been 71.4 GtC yr-1 had it not been for global land use. The increase in potential productivity was a result of the anthropologically induced carbon fertilization

effect of an increasing CO_2 concentration in the atmosphere. However, the actual NPP was 65.8 GtC yr-1 (Richardson et al. 2023). This gap can be conceptualized as Human Appropriation of Net Primary Productivity (HANPP) and signifies the difference in percentage between the potential and actual NPP. To match the current international GHG accounting system and its effectiveness, country-specific measurements of HANPP or similar methods need to be implemented. For companies, the Science Based Targets Network has already taken a step in this direction (Segal 2023). Consequently, increasing transparency of value chains in relation to effects on biodiversity requires that new advances in science and technology are recognized by the political system, the major companies driving international trade, and the scientists adapting new data collections.

Context and application

Measures to increase value chain transparency must be implemented at local and national levels, but are only meaningful within a coherent trans-regional or global context. Trading goods must be linked to similar data systems in exporting and importing countries to trace full value chains. Such interactions require multinational frameworks – especially considering the many links present in modern trade (UNEP and TESS 2023). When it comes to an accounting system of biomass only, global accords can facilitate appropriate assessments and boundary setting as the consequences of biodiversity loss are global.

Relevant actors

While scientific actors and NGOs play a part in pushing the limits of public data collection concerned with the adverse effects of specific commodity trades, large and international companies within the private sector are vital for showcasing to the political-administrative system how detailed, non-tamperable information can be linked up with specific products across a value chain. Frontrunners in the private sector can create a permission structure for political decision-makers to make environmental data tracking mandatory through national legislation and multinational trade agreements (Slawinski 2021).

The scientific community plays a significant role in demonstrating that meaningful methods of biomass or land use accounting can provide the foundation for new targets under the Kunming-Montreal Global Biodiversity Framework. Finally, it is a political decision whether to implement further binding international targets within national legislation.

Implementation strategy

The first step in the implementation of this idea is to present it as viable to decision-makers in the private and public sectors. In terms of geolocation-based transparency mechanisms, this is a question of displaying state-of-the-art technical solutions, while combining these with increased resources for on-the-ground monitoring in the countries of origin – especially if human rights and social equity are to be included concurrently with environmental indicators (West 2021). When it comes to the accounting system of biomass, a wider introduction of concepts like HANPP can change mindsets regarding what nature is, and what our land use means for the overall terrestrial biosphere. In this way, an accounting system of biomass or land use can provide decision-makers with a tool to set specific limits, ut it can also serve as a new way of interpreting nature-human interactions.

Challenges and barriers

Additional transparency in value chains and an accounting system for biomass can serve as barriers in the trading system. The introduction of such barriers can have positive effects for socio-environmental outcomes, as it is expected to decrease the amount of products and entire business sectors that damage important natural ecosystems. With this effect, an introduction of barriers in the trade system will, of course, be met with opposition from actors that benefit from lack of transparency and boundary setting today. This is a major challenge and an obstacle to the implementation of this idea, as the companies that will have the most to lose are often situated in the most politically powerful countries of the Global North.

Maturity

Success criteria

The most important criterion to measure the success of the implementation of supply chain transparency is to which degree consumers, businesses, and political-administrative regimes actually get, and can process, additional information about internationally traded commodities. This change can be measured both quantitatively and qualitatively over time. The ultimate success criterion for an accounting system of biomass is whether the system leads to political limits affecting the part of the economy that is related to land use, and whether these limits in effect decrease the human appropriation of Earth's terrestrial biomass.

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c. Science-based selection of marine protected areas

Description

This idea addresses the benefits of operationalizing regional management tools for designating marine protected areas (MPAs) for the protection of marine life and biodiversity. The human pressure on life in the ocean, including the loss of marine biodiversity, is in general of less public concern than environmental problems on land. Regardless, marine ecosystems are particularly vulnerable due to the intensified exploration of ocean resources, increased traffic, establishment of infrastructure, and pollution from land. In the UN Kunming-Montreal Global Biodiversity Framework for protecting marine biodiversity, a goal to be reached by 2030 is that areas of particular importance for biodiversity and ecosystem functions are effectively conserved and managed (CBD 2022). MPAs need to consider the complex interactions between life cycles of marine organisms, transport by ocean currents, and their role in coupled ecosystems between the atmosphere (birds), the open water (fish, marine mammals, plankton), and the seabed (benthic fish, corals etc.). The coupling between the open ocean and near-shore coastal areas, together with human activities, further complicates the task of optimally designating MPAs. In contrast to land-based management, the majority of biomass in the marine environment is non-stationary and is transported by ocean currents where plankton and larvae are drifting freely and followed by organisms from higher trophic levels, such as fish. Thus, remote connections between important areas in different phases of an organism's life cycle must be considered when MPAs are designated, e.g. hot spots of biological production versus spawning areas. Similarly, the close coupling between ecosystems in the free water column, on the seabed, and at the surface must be considered. Although indications of hot spots of marine productivity and, thereby, potentially sensitive areas for biodiversity may be identified from satellites, this information only gives a superficial and indirect information of these complex interactions in the ocean. Other and more direct tools are therefore required to identify critical areas for ecosystems and biodiversity. Monitoring of the marine environment is, in general, mainly carried out via national monitoring programs, and in many cases these efforts are coordinated at the regional level, e.g. transnational collaborations on environmental monitoring outlined in the HELCOM commission for the Baltic Sea or within the European Union. Ocean modeling is often included as part of direct observations for upscaling to larger spatial and temporal coverage. However, modeling in relation to MPAs is currently not applied as a management tool, although new scientifically based approaches, as described in the following, have been developed during the last decade.

We propose to implement ocean modeling as a basic tool for designating MPAs at national and regional levels State-of-the-art ocean modeling (i.e. describing transport by ocean currents and mixing) can provide information on spatial distributions of biomasses and productivity, and quantify the impact of nutrients and pollutants from land, rivers, and point sources. Additionally, these tools can calculate connectivity between the water column and the seabed (O´Leary and Roberts 2018) and between remote locations that are connected via ocean currents (Rossi et al. 2014). Ocean currents influence the life cycle and distributions of many marine organisms, both directly by acting as a vector in the transport of marine plankton from A to B (Figueiredo et al. 2022, Bendtsen et al. 2023), and indirectly by supplying food for higher trophic levels, such as zooplankton, fish, and marine mammals (Selkoe et al. 2016). Ocean modeling is, therefore, a suitable and feasible tool for designating relevant areas as MPAs for sustaining healthy marine ecosystems and protecting biodiversity and endangered marine species.

Context and application

A science-based selection of MPAs will be guided by the UN Biodiversity Framework and will focus on "areas of particular importance for biodiversity and ecosystem functions" (CBD 2022: 9). Ocean currents are by nature not aligned with national boundaries, and this implies that MPAs, in general, must be designated based on regional analyses where transnational transport and connectivity are considered. This also involves strengthened regional and international coordination of marine conservation, whereby nation states agree on how to approach our greatest environmental common, the ocean. This may also involve both financial and technical support to areas of the world where such needed resources for adequate marine modeling and conservation are scarce or not available.

Relevant actors

Designation of MPAs should be included in national environmental monitoring programs and be implemented in regional strategies in intergovernmental organizations that regulate or monitor the marine environment, e.g. HELCOM for the Baltic Sea, ICES for the North Atlantic, or the EU for European seas. As is evident, these collaborations are largely situated in the Global North, and it would be of interest to investigate similar potential collaborations across the Global South – ideally with financial and technical support from the international community, in acknowledgment of the common interest in healthy oceans globally. MPAs would benefit the global public by ensuring a sustainable exploration of marine resources. Utilizing this approach could also stimulate recreational activities and tourism at sea. Opponents could potentially be (1) fishing industry operating at or near MPAs, (2) mining, oil, and gas companies with marine infrastructure, (3) offshore wind farms, and (4) shipping industry and their route planning at sea.

Implementation strategy

To achieve a regional science-based designation of MPAs by 2030 involves both the build-up of local expertise and the engagement of intergovernmental actors. At the national level, further development and coordination of know-how on monitoring and modeling, in relation to MPAs, is required. At the regional level, coordinating initiatives have to be established.

Challenges and barriers

A major challenge is the general lack of public awareness when it comes to the marine environment and the importance of MPAs. This may limit resources available to marine conservation. In addition, transnational coordination may be limited by national interests or conflicts. Thus, strengthened international collaborations are a prerequisite for adequate marine conservation.

Maturity

Success criteria

- Implementation of operational regional management tools for designating MPAs.
- Establishment of regional coordinating fora for science-based designation of MPAs.
- Increased science-policy collaboration on designating MPAs through ocean modeling.

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Postscript

By Rune Larsen and Lise Kjølbye

It should come as no surprise that discussions between people from all branches of academia, and from across all inhabited continents, come with certain challenges and unforeseen obstacles – and this was certainly also the case for us. From the beginning, our team agreed that inclusiveness is vital to a successful experiment. This meant that problems and challenges could be dealt with from myriad of perspectives, positions, and experiences. Together with awareness of the carbon footprint that would result from physical meetings across countries, this led us to settle on an online free-of-charge and inclusive format.

Nevertheless, some inequalities and tensions resulted from the online format – although it did provide us with opportunities for connection that would not have been possible under normal circumstances. For example, varying degrees of Internet connectivity and technological access revealed the first signs of global inequality. In addition, it was evident in all our discussions that, before any concrete research-based ideas could be negotiated, the groups had to create a common language as a baseline for collaboration. For some groups, the process of creating this common ground and language and establishing consensus was smooth. For other groups, both epistemological and ontological differences resulted in different or even conflicting views of the ideal path to transformation.

Instead of trying to even out the differences between views in and across groups, our facilitators highlighted how some ideas may conflict and thus represent the tradeoffs inherent to all decision-making processes. Therefore, it is important to keep in mind that all ideas result from dialogue among strangers who met through Transformation Labs.

Beyond generating novel ideas for global societal transformation, our process fostered new interdisciplinary alliances as well. We hope that our participants will benefit from this extension of their academic network, and develop new interdisciplinary research products in the future. Likewise, we believe that this experience has revealed the knowledge that can be created when we leave our comfort zones and engage in challenging (and at times humbling) dialogue with people from radically different backgrounds. In short, this idea catalog is not the only product of our experiment. Rather, it is the manifestation of a process that may yield yet unknown and unforeseen fruits in the future.

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