Resilience Frontiers Initiative

Eight Pathways towards a Resilient Future

INTRODUCTION

Following the identification of foresight and innovation as an area of focus of the UN Chief Executives Board for Coordination, and in line with ensuing discussions on the impact of frontier technologies, the UNFCCC secretariat is advancing "Resilience Frontiers", a foresight-driven initiative to address long-term global resilience to climate change beyond 2030. This two-year initiative is an action pledge under the Nairobi work programme on impacts, vulnerability and adaptation to climate change. It aims at harnessing the potential of paradigm-shifting frontier technologies and emerging social trends towards long-term global resilience.

The initiative was kicked off by a brainstorming event in Songdo, the Republic of Korea, on 8–12 April 2019.1 The event brought together 100 thought leaders of diverse backgrounds, whose expertise covered 15 different themes which were clustered as follows:

- Drivers of change: Artificial intelligence, Autonomous systems, Biotechnology, Satellite technology, and the emerging Sustainability ethos;
- Basic needs: Water, Food, Health, Nature, and Human security;
- Institutional setups: Finance, Education, Law/governance, Human habitats, and Values.

The event applied a foresight methodology that integrated the collective intelligence of all participants in a networked fashion, and which resulted in the elaboration of the following eight pathways:

1. Transforming humanity's interface with nature, building on indigenous values;
2. Applying lifelong learning for environmental stewardship;
3. Ensuring universal equitable coverage of, and open-access to, (big) data and information, and related benefits to human wellbeing;
4. Managing water and other natural resources in a participatory and equitable way;
5. Managing transboundary considerations equitably;
6. Optimizing future health and wellbeing using a holistic and ecosystem-centred approach;
7. Mainstreaming regenerative food production; and
8. Developing transformative financial instruments.

The following briefs for the above eight pathways are intended to serve as a starting point for articulating, by the end of 2020, policy-relevant roadmaps which identify milestones for the achievement of these visions during the next decade. These milestones will reflect concrete actions and turning points that would incentivize the move towards the identified desirable futures that will characterize a resilient world post-2030.

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1 http://www.resiliencefrontiers.org/

I.   Vision

Human activities have a sustained net positive effect on nature.

II.   Rationale

Our current mode of development is eroding the health of nature, and it is bound to destabilize the foundation of our quality of life, health, food security, livelihoods, and economic prospects.

We have significantly altered three quarters of the land-based environment and about 66 percent of the marine environment, sending one million species to the brink of extinction.

Despite the overexploitation of humanity's life-support system, 8.6 percent of the world's population was still living in extreme poverty as of 2018.

Worse yet, such unchecked pressure on nature comes from a global population of 7.7 billion people. The world is projected to become a lot more crowded. An estimated 10.9 billion people will be relying on the same natural systems to meet their needs by the end of the century. Treating symptoms, e.g. with population control measures without addressing root causes for a change in our mode of development, can only help by delaying the inevitable dire consequences of our unsustainable modus operandi.

Positive transformative changes are necessary to restore and maintain a state of equilibrium for living in harmony with nature, and ultimately enable human activities to benefit nature. In turn, the health and integrity of nature ensures the long-term survival and prosperity of humanity as a species.

Through recognition and respect for the benefits that nature provides humanity, indigenous peoples maintain their unique relationship with their surrounding environments. Such relationship has enabled the indigenous peoples of the world to maintain stewardship of what is now estimated at 80 percent of the world's remaining biodiversity.

III.   Opportunities

- The worldview of indigenous peoples, especially their values vis-à-vis nature and their sustainable practices, offers replicable opportunities on how to best maintain the delicate balance between humanity and nature. Indigenous peoples' holistic and relational approach to nature fosters a culture where the interconnectedness of the fabric of life inextricably positions humans as a positive part of the nature. Such a culture would secure the long-term wellbeing of all people and the planet.
- Frontier technologies also present promising potential, particularly if they are accessible and usable by everyone. The emerging technologies, if applied with the wellbeing of people and the planet in mind, would help address climate change challenges and fully restore ecosystems to their sustainably functioning state.
- Socially inclusive and value-based multilateralism could serve as an effective channel to leave no one behind, while contributing to raising awareness and mainstreaming practices that are nature-proof.

- Globalize local solutions.

IV. Challenges

- The incumbent profit-driven market system leaves little room for prioritising nature.
- The awareness of the world's dependence on nature for survival is insufficient. International and multilateral processes are not designed to represent "global" interests but rather the aggregation of national interests.
- The aggregation of national interests does not amount to the global interest of human sustainability.
- Current climate change and environmental narratives often miss a crucial point. Efforts to curb climate change and to restore nature are not about saving the environment, but rather about meeting our survival needs – food, shelter, health, culture, among other needs.
- Ingenuity gap.
- Shifting baseline – individuals are often impassioned by the knowledge of the past. We need to use technology to facilitate intergenerational transmission of information.
- Social conflict over natural resources.
- Gap where the decisionmakers are not so close to the indigenous groups or their practices. The role of tech to help understand their stories is a challenge.
- How to protect the indigenous communities data and information?

V. Objectives to fulfil the vision

- Promoting a holistic approach to human wellbeing, which is intimately intertwined in the health and integrity of nature.
- Raising awareness on the long-term interests of humanity, for a sustainable and healthy relationship with nature, as opposed to unstainable corporate and national sub-interests.
- Identifying concrete ways to employ frontier technologies to foster values of sustainability.
- Reconnect with and value nature. Soil and land must be the sine qua non of what we do.

VI. Examples of possible activities mapped onto the objectives

- Enhance peoples' exposure to nature and foster a sense of belonging through awareness raising campaigns, immersive field visits, ecotourism, nature programs, parks and green spaces.
- Foster open and inclusive dialogues to further co-shape and promote this vision, and bring together individuals with diverse backgrounds and knowledge systems knowledge.
- Identify and mainstream values of sustainability of the interconnectedness of human beings and actions with nature while promoting the understanding of humans as a positive part of the nature.
- Identify and implement learning-by-doing activities to strengthen sustainable human-nature relations while helping to fulfil the vision.
- Leverage existing and diverse communication channels, such as social media, art and music to foster and mainstream a nature-inclusive global culture.
- Inform people of real-time changes in nature by developing and deploying inclusive frontier technologies.
- Mainstream economic activities that are socially and ecologically sustainable.

- Design policy and legislative measures to align human activities with the long-term health of nature.
- Preventing false narrative and false data.
- Creating and promoting shared language/ narrative.

2. APPLYING LIFELONG LEARNING FOR ENVIRONMENTAL STEWARDSHIP

I. Vision

A global shift in consciousness toward collective responsibility for environmental stewardship and a sense of belonging to nature.

II. Rationale

In an era of disappearing cryosphere, surging storms, and raging wildfires wreaking havoc on peoples' lives and ecosystems, building a climate-resilient world for all requires enhanced understanding and stewardship of nature, catalyzed by lifelong learning.

The conventional Rs (i.e. Reduce, Reuse and Recycle) are no longer adequate to address climate change challenges and restore nature to its full vitality and integrity.

The lifelong learning paradigm should foster a new complementary set of Rs (i.e. Reconnect, Restore and Regenerate) and provoke a collective consciousness awakening of our responsibility for environmental stewardship.

For this vision to succeed, we need to embrace the four pillars of learning proposed by the UNESCO Delors Commission: 'learning to know', 'learning to do', 'learning to be', and 'learning to live together' including learning to transform. Such pedagogical approach, when embraced both formally and informally, could adjust individual biases and interest towards a single set of ontology reconnecting us easily with nature, not as a selective course or a one-off field trip, but through fostering life-long learning and safeguarding of nature.

Learning activities need to encourage a dialogue between and across different generations, ethnicities, religions and other micro sets of identities so as to facilitate universal lifelong learning for environmental stewardship.

The wellbeing of nature, our only life-supporting system, has to be at the front and center of our pursuit of knowledge and economic activities to ensure that future generations can enjoy the same benefits that nature bestows upon us all.

III. Opportunities

- Relevant learning initiatives exist for replication, including those relating to regenerative agriculture, community-based management, etc.
- The rise of frontier technologies, if aligned with the learning objectives associated with this vision, can help reconnect people with nature.
- There exists a global momentum generated by the youth, which can be harnessed in a way that can engage their readiness to learn new world views that can help support the transition to a sustainable world.
- Technology-mediated transparent enforcement of environmental policies and programmes.
- Develop trade taxes to reflect and address cross-boundary pollution and embedded emissions.

- Require/encourage firms to report on their ecological footprint.
- Have more role models for demonstration effect. Lead by example by practicing what we preach.
- Deploy food systems as a medium to reconnect human with nature.
- Develop emotional connection and empathy by getting personal stories out by using technology.

IV. Challenges

- The current model and incentives for the pursuit of knowledge do not attach enough importance to environmental stewardship.
- Rapid urbanization and digitalization of our world have closed ourselves to the participatory life of our senses – that is, the lack of exposure to nature. We seek truth from technologies that screen us off from nature and deprive ourselves of the opportunity to foster a sense of belonging to nature.
- Diverse ways of knowing, including indigenous and local knowledge and stewardship of nature, lack sufficient political and economic support. For example, indigenous peoples are regarded as the stewards of 80 percent of the world's remaining biodiversity; while indigenous peoples represent less than 5 percent of the world's population, they represent 15 percent of the world's poor.
- Nature knows no political boundaries. Stewardship of the environment around us often requires cross-boundary and multi-stakeholder collaborations.
- The digital divide and gaps in knowledge dissemination continue to leave millions of people behind.
- The potential for the value-action gap *(knowledge-attitudes-practice gap, attitude-behavior gap, intention-behavior gap, etc.)* syndrome to undermine environmentally supportive behavior is more probable.

V. Objectives to fulfil the vision

- Extending pedagogical practices beyond screens and classrooms and turning greenspaces into living knowledge/learning hubs. Educators help new generations to understand the role of nature as our only life-supporting system.
- Connecting stewardship of nature, youth development and life-long development.
- Bridging the widening gap between growing urban populations and nature.
- Harnessing the power of frontier technologies to bridge the gap between urbanites in the built environment and nature.

VI. Examples of possible activities mapped onto the objectives

- Introducing new pedagogical models that encourage people's interaction with nature and foster a sense of belonging to nature.
- Creating economic opportunities that place lifelong learning for environmental stewardship at the front and center instead of having it as a co-benefit.
- Designing compulsory ecological civic duty enlistment arrangements – as a service to nature;

- Engaging "alternative" teachers in this new pedagogical approach, including indigenous experts.
- Building the capacity, both the technical knowhow and resource mobilization, of individuals and communities to gain a sense of agency and take stewardship actions.
- Integrating environmental issues in the metrics for ranking schools globally.
- Creating centers of excellence for environment studies in schools, communities, faith-based organizations (churches and masjid), etc. and incorporating foundational environmental topics in school curriculums.
- Equipping consumers with quality supply chain data and to enable them to compare products' ecological footprint (e.g. life-cycle carbon budget).
- Pricing environmental externalities to reflect the true cost of a product.
- Introducing a universal basic income to meet people's basic needs first for them to think about environmental stewardship.
- Reforming economic indicators to go beyond GPD to human wellbeing.
- Conduct targeted outreach to Hollywood and Bollywood and, leverage the film industry to stimulate discussions on and foster collective environmental stewardship.

I. Vision

Credible multidisciplinary data and its processed outcomes are openly available and mobilized to create a more equitable, sustainable and resilient society to enable global wellbeing.

II. Rationale

The evolution of data technologies, both in terms of scaled-up scope and quantity of data gathered, as well as in the addition of value through AI processes, can happen in ways that would considerably benefit the wellbeing of humanity, but this may not necessarily materialize without concerted efforts.

III. Opportunities

- We are moving into a new age for satellite imagery, representing a new era for the space sector, characterised by a new playing field. This era is unfolding through interaction between governments, private sector, society and politics.
- Information from satellites will be fully integrated with other observations and data. It will be processed using big data analytics and AI to produce real-time, high-resolution, relevant information for society to provide collaborative data-driven and transformational risk-informed decision-making tools for policy and investment, while also monitoring ambition progress.
- Open-source data will be able to be combined with models and scenarios on relevant scales e.g. systems, cities, to provide full risk assessment and planning scenarios and options.
- Improved analytics will offer active learning from past experience and help identify teleconnections in systems over vast scales that will greatly improve planning and predictions.
- Open-sourced social data, such as that available from 'citizen-science' initiatives, not only provide locally sourced, community-relevant data, but also increases the agency of non-state, civil actors and the support of resiliency enhancing interventions. Mainstreaming the use of this data in society can make the public stewards of their own environment with an active role in its monitoring and input into decision-making.
- Changing the modes of work from sequential to simultaneous modes: flows of work will not be the same as they are now but will be easily accessible and interconnected (dynamic/smart apps, open data, storymaps, visualization, smart mapping, portals).
- Advances in synthetic biology are creating possibilities to archive data using DNA transcription. Archiving data in this way offers an increase in storage capacity and decrease in required power by several orders of magnitude over today's techniques.

IV.   Challenges

- Private sector ownership of many channels of data collection and of the means for applying AI processes to them will limit equitable use of their benefits.
- Coverage of data collection is not universal, and inevitably introduces cognitive and discrimination bias in future applications of data actually assembled. Data collection is constrained by internet coverage and reliable power.
- In AI applications only the input and output of data can be observed. Algorithms will take decisions based on rules they have learned but which are too complex to verify and control effectively.
- Low availability and quality of data, especially in less developed countries, will widen the gap in access to data and subsequent applications.
- Local and indigenous knowledge holders whose knowledge has been exploited commercially in the past may be less enthusiastic to collaborate in the future. Scientists and policy-makers do not traditionally operate in ways conducive to the inclusion of diverse varieties of knowledge.
- Privacy concerns exist over the large-scale coverage of remotely-sensed data and its use to exploit resources over the interests of people, such as face recognition technologies and their uses.
- Synthetic biology is in very early stages of development, and while showing promising experimental results, is currently only potentially viable for storing archival data, and without efficient remote access.
- Technological advancements might build trust in terms of transboundary cooperation but at the same time these advancements might not fully consider social values and social cohesion.
- How can we use data to build trust?

V.   Objectives to fulfil the vision

- Identify current (and potential new) collaborations between stakeholders and information producers. Use the interactions of these networks to identify requirements for dissemination and transferal systems.
- Mainstream awareness of future data and information technologies, and the new areas of value addition that they contribute. Create opportunities for engagement and feedback. Emphasize the importance of open data.
- Identify and promote effective mechanisms for inclusive access to data and processed outcomes, as well as for universal coverage of its collection.
- Define arrangements for lifelong learning to enable the achievement of this vision.
- Technological advances could also mean building capacity of those who are not otherwise technologically competent. However, it is also important to reciprocate the learning and capacity building. For example, indigenous peoples need to build capacity while policy makers and other stakeholders need to build their understanding of the indigenous knowledge.
- Access to data also means that people should know how to use it.

VI.   Examples of possible activities mapped onto the objectives

- Identify good practices/innovative initiatives that are being incubated and can contribute towards this vision.
- Demystify big-data and emergent technology. Make it practically understandable and intelligible in order to build public support for inclusive coverage and access to its benefits. Strive for communicative inclusivity.
- Build open data systems within the United Nations system to support our current work and introduce innovations towards the vision in this pathway.
- Trial-run AI solutions against existing methods and known good practices.
- Blockchain-based UN system framework for ethics in data generation and processing, e.g. in setting rules for algorithms.

I. Vision

Facilitating conservation, restoration and equitable management of natural resources, particularly with regard to water resources and biodiversity. Mainstream the creation of robust, comprehensive and detailed information repositories and maps of natural resources, that are thorough and universally accessible. Communities depending on those resources manage them jointly, including the transboundary and global commons which will also be managed in the same manner that supports a thriving and regenerative natural resource base.

II. Rationale

Addressing the lack of a broad and comprehensive accounting of natural resources, coupled with an understanding that those resources are essential for collective wellbeing and communal and ecosystem health, will result in effective depoliticized decisions that prioritise long-term sustainable exploitation relative to the needs of humanity and nature.

III. Opportunities

- Geospatial technology changes the current way of managing and monitoring the atmosphere, land, and water resources into modern digital precise spatial information.
- Future data acquired and processed through frontier technologies, including through the use of geospatial technology, if analyzed and modelled properly, can be visualized as a dynamic informative map. When layered with more attributions and information, complex issues can be understood within seconds and problem areas can be identified instantly. Insights derived from the integration of geospatial and non-geospatial data can help achieve a healthy and thriving natural resource base.
- AI mapping of natural resources can allow for the continuous update and assessment of emergent risks and resilience opportunities with longer lead times to act before impacts materialize.
- Increasing public knowledge, especially recently of the oceans, has spurred political and private will for conservation and remediation action. Analysis of how these issues were raised and came to prominence in some areas, and how they can be replicated, enhanced and maintained over time can inform future interventions.
- Increasingly interconnected communities – within urban centres, rural areas, regionally, and globally – have played a role in broadening the responsibility for the management of resources, even when a community's role may not be explicit. If this collective responsibility can be enhanced without exacerbating possible competition for resources, co-management opportunities within the communities can emerge naturally based on their joint needs.
- Leverage, strengthen and replicate good practices in community-based natural resource management as well as sustainable forest, land and water management.

- Urban centers at national, regional and global levels could be designed using a combination of frontier technologies, and community- and nature-centered solutions (for example solutions that create equitable opportunities for all groups, sexes and ages and that support a thriving and regenerative natural resource base).
- Networks to monitor resource availability, such as mobile and static ocean floats, passive sensors on water courses and satellite imaging, are expanding. The interlinkage of these networks allows wide-scale tracking of resources which can inform future policy and local planning.
- The rise of civil actors engaging with policy making and governance poses the potential to link initiatives across regional boundaries and national borders. The management of shared resources by these communities across national borders increases the equitability of management, and offers a potential connection point to national and international policy. Local actors will benefit from the input of regional data sources from frontier monitoring technologies, which enable actors to act as focal points for the management of resources on the scale of the interdependent communities.
- The inputs of resources to the metabolism of human settlements, if effectively assessed, illuminate the place of such settlements in the overall ecosystem, and can promote a more holistic approach to the management of human settlements in unison with the surrounding natural systems.
- Citizen science and social reporting on natural resources provides a low-cost on-the-ground method to further citizen engagement, increase agency and gather real-time, community-relevant data.
- The promotion of citizens' wellbeing is interlinked to the wellbeing of natural resources. Making this link explicit promotes increased support for sustainable management.
- Multilateral agreements/frameworks could facilitate equitable management of natural resources and help address two issues: a) avoid/get rid of privatization of natural resources (e.g. Arctic) and b) widen the scope of the "costing" of natural resources beyond their economic values.

IV. Challenges

- Prioritisation of short-term over long-term gains. Future discounting.
- Potential future lack of access by some to data and information products arising from frontier technologies.
- Frontier and AI technologies might not fully consider underlying values that are core to equitable and participatory management of natural resources.
- Management of natural resources at different levels (local, national, regional and global) requires equitable allocation of support (e.g. funding and other resources) at all these levels, which could be challenging due to competing national priorities.
- Support, including funding, for the management of transboundary resources if political will is lacking.
- Absence of robust multilateral frameworks might hamper equitable and participatory management of natural resources, for example: privatization of natural resources.
- Mapping of natural resources is a considerable challenge in terms of spatial scale. Resources may depend on unmapped or unknown subsurface features. Other resources may exist at depth in the earth or in the ocean and be difficult to identify, track or assess.
- Recognition of natural resources must exist beyond what can be immediately defined as valuable in a monetary sense. Resources have intrinsic value that is not immediately

obvious in national assessments but essential to the functioning of the ecosystems within which society operates.

V. Objectives to fulfil the vision

- Planning for modalities to acquire future data and information that can be easily accessed / interpreted (including geospatially) and mainstreamed into decision making.
- Feedback of future data into the mainstreaming of environmental stewardship and shared responsibility.
- Use of frontier technologies to induce public buy-in to environmental stewardship.
- Encourage community cohesion through joint resource management.
- Establish regional networked platforms for the management or resources not delineated by borders or easily identifiable boundaries.
- Need to integrate and distribute equitable social responsibilities (gender roles for both men and women).
- Importance of understanding the full environmental cost of any production system and internalize the cost of externalities, as well as distribute the cost equitable that minimizes undue burden on any country/region.
- Development models need to be redefined in a way that recognizes and encourages sustainable food production systems.

VI. Examples of possible activities mapped onto the objectives

- Coordinate to provide a digital ecosystem for the environment to bring together data, algorithms and insights for resilience and sustainable development.

Source: https://medium.com/@davidedjensen_99356/building-a-digital-ecosystem-for-the-planet-557c41225dc2

- Roll out collective management campaigns to involve the public.
- Prioritize ease of use and social stewardship in engagement strategies.
- Build awareness to promote resources as not only inputs to industry, but also to ecosystem and human wellbeing.
- Exploit existing opportunities in formal and informal resilience networks.

- Identify good practices and apply lessons learned from community-based natural resource management worldwide.

5. MANAGING TRANSBOUNDARY CONSIDERATIONS EQUITABLY

I. Vision

A holistic and well-defined transboundary arrangement is in place, which ensures human wellbeing, equity, dignity and inalienable rights, including dignified resettlement of persons displaced by climate change impacts and other hazards.

II. Rationale

Transboundary arrangements are needed to ensure trust and coordinated actions of various stakeholders rather than competition across borders, especially when faced with the adverse effects of climate change and other phenomena arising from humanity's unsustainable practices over the past two centuries.

III. Opportunities

- Existing international arrangements that promote cooperation for shared resources and transboundary environmental impacts can serve as a starting point to leverage managing transboundary considerations arising from climate change.
- Technological solutions are starting to emerge, and can evolve into transnational advocacy networks built on interconnected channels of data sharing, satellite imagery and real-time mapping of migration patterns, which would assist in developing predictions to inform decision making at a higher level.
- Multilateral funds are already enabled to support transboundary considerations, for example through regional projects, including those relating to climate change induced human mobility.
- Existing regional integration arrangements (e.g. the EU) provide lessons for replication/adjustment into future contexts.
- Multinational corporations having businesses in transnational settings are likewise at stake in dealing with transboundary issues hence can be tapped for resources i.e. technology, subject matter expertise, funding etc.
- Consumers economically benefit from global or interconnected supply chains for goods and services. Disruption of connectivity can result in financial damages or material wellbeing, thus may be amenable to creating sustainable transboundary approaches.

IV. Challenges

- There is a lack of adequate legal and policy frameworks that would allow for smooth transboundary collaboration in managing environmental concerns and ensuring human wellbeing.
- There is a lack of understanding and appreciation of the transboundary nature of environmental concerns (including, e.g., geographical differences of cause and affects), and of the need for collective arrangements to optimize associated sustainable pathways.
- While people displaced within their own countries are covered by national laws, international human rights law, the United Nations guiding principles on internal

displacement and a few regional instruments, a serious legal gap exists with regard to cross-border movements in the context of environmental hazards such as those arising from climate change.

V.   Objectives to fulfil the vision

- In the long term, creating awareness on the need for a prominent, comprehensive and globally endorsed strategy for sustainable transboundary management of natural, economic and human resources as well as for responding to adverse impacts arising from environmental hazards.
- Designing regulatory and policy frameworks that can contribute to this vision.
- Promoting technologies that can induce transboundary cultures, e.g. regional data management for decision making.
- Think of limits within a biosphere in transboundary cooperation.

VI.   Examples of possible activities mapped onto the objectives

- **Education and public awareness:** Educating policy makers, including those at supranational entities in the regions, through legal and policy capacity-building exercises could be complemented with generating public interest and awareness through various media channels. Involving the private sector, in particular transnational corporations, through focused discussions, dialogues and workshops, would enable tailoring evolving frontier technologies to support the implementation of the vision.
- **Multi-stakeholder dialogue:** Organizing an inclusive and participatory multi-stakeholder dialogue with adequate engagement from all sectors would produce elements for legal and policy frameworks to support this vision.
- **Technological interventions:** Developing parameters for the use of frontier technologies, including high resolution remote sensing satellites enabling optical precision and real time remote sensing would allow the monitoring and management of human mobility due to climate change as well as other transboundary aspects of natural resource management, including migratory species, and sustainable and regenerative ecosystem management.

6. OPTIMIZING FUTURE HEALTH AND WELLBEING USING A HOLISTIC AND ECOSYSTEM-CENTRED APPROACH

I. Vision

Implementing new approaches to the design of future neighbourhoods that optimize human health through maximizing immunity and minimizing ailments. This will be created through balanced synergy and a healthy interface between housing units, ecosystems, and food production within those future neighbourhoods.

II. Rationale

Good health and wellbeing is intrinsically linked to the sustainability of ecosystems and of food production, the quality of the environment, and to the geometry of the natural and built environments (biophilic effect[2]).

III. Opportunities

- The internet of things, big data and artificial intelligence create opportunities for optimization of health. Such technologies can also be used to foster sharing and co-creation of knowledge to support nature conservation and regeneration, as well as promoting innovative nature-based solutions to improve human health and wellbeing.
- Biotechnology can also contribute to the development of a holistic health system to ensure sustained ecological health.
- Biomimicry is becoming more recognized as a design guidance, and will be particularly useful in this pathway.
- Some of the precursors to these ideas already exist and can be built upon, especially pilots can serve to increase awareness.
- Use of future technologies in health care system such as drone delivered medicine and digital disease diagnoses (tele-medicine to deal with the treatment of diseases in a faster way).
- Adverse effects of climate change on human health can be the narrative to make changes (pervious successful experience with for example ozone depletion).
- IPCC Working Group 3 is working on the interface between health and building design in a way that is more connected to nature.
- This pathway is relevant to urban planning. Examples of such future neighborhood and transformational zoning is already emerging (Toronto example).
- Foundation of Green World Bank (similar to the World Bank) that allows for innovations and for investments to fail.

IV. Challenges

- There is insufficient awareness of the world's dependence on nature for health and wellbeing. We need global awareness of the real value of ecosystem services.

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[2] Biophilic effect means that a form (whether it is a building, a neighbourhood, or urban space) has to be built in accordance with principles that derive from the natural organization of living matter.

- Biodiversity loss presents a threat to human health and hinders ecosystems' ability to provide food.
- There is a perception that economic costs would exceed economic benefits.
- The realities of corporate competitiveness in the construction industry are aligned with unsustainable practices.

V. Objectives to fulfil the vision

- Identifying how different components of frontier technologies can be used to foster an environment which capitalizes on nature for maximizing health and wellbeing, in particular employing frontier technologies in health as they relate to nature, including to support the establishment of future neighbourhoods as human habitats that optimize the health of all living beings;
- Developing a detailed narrative that describes the technicalities of the system of relationships encompassing the human, the animal and the vegetal worlds as part of a global ecosystem, human habitats and food production, to serve as the basis for the establishment of future neighbourhoods.

VI. Examples of possible activities mapped onto the objectives

Education and awareness
- Spread awareness of human beings' dependence on nature for health and wellbeing, with the aim to creating a social movement to this end.
- Pilot green spaces as learning hubs to orient the learners' mindsets towards the creation of the proposed future neighbourhoods. Consider how cities can change zoning to encourage such green spaces. Consider how cities instead of companies can create digital (future) neighborhoods.
- Recognition of ecosystem value and awareness raising that has implications for human health.

Policy and guidelines
- Develop guidelines and policies to encourage developers to use biomimicry design from the outset of any construction project, as well as to renature current human settlements, including through zoning approaches.
- Establish "future neighbourhood" demonstration projects as a symbiotic biome that reconnects people with nature, optimizes health and wellbeing and serves to evolve values towards a collective consciousness of supporting ecosystems.
- Design business models that would engage providers of financial instruments in developing strategies to incentivize developers of settlements to adopt this new living model. Creation of a World Bank or Marshall Fund to fund this transformation. Creating instruments that allow investments to fail.

Other
- Foster the use of large-scale sensor networks (IoT) using big data and AI to closely monitor the health-related performance of our ecosystem and food systems in our future neighbourhoods, including as a step towards possible automatic interventions using drones.

- Hyper local real time information including air quality parameters/ other environmental risk factors that are relevant to human health to be accessible.

I. **Vision**

The access to, and quality and availability of, nutritious food for all is ensured, including through regenerative food systems which renew nature, confer resilience and ensure food security.

II. **Rationale**

Demand for food will continue to increase as the world's population continues to grow and productive land and ocean areas degrades.

By 2050, less than 10% of the land surface will remain free of human impact. Such mismatch between supply and demand for food is aggravated by food waste as well as by competing demands for land, including for housing and energy production.

Current predominant unsustainable food production systems are depleting our natural resource base rather than enhancing it. Climate impacts add an additional threaten to food security that makes it even more urgent to reform food production systems.

A decrease in global biomass of marine animal communities, their production, and fisheries catch potential (approx. 10-25%), and a shift in species composition are projected over the 21st century in ocean ecosystems from the surface to the deep seafloor under all emission scenarios.

There are approaches to food production which add, rather than subtract, value to nature. Such approaches generate net gains 'natural capital' – soils, biodiversity, water cycle, carbon storage, etc. Mainstreaming these would entail a paradigm shift that secures sustainable livelihoods, protects and preserves ecosystems and biodiversity at the same time, and is low-carbon and climate-resilient in both global agriculture and fisheries.

For example, in global agriculture, away from industrial agriculture and monoculture towards strengthening smaller-scale applications of regenerative (e.g. diversified agroforestry systems and sustainable practices of traditional populations).

III. **Opportunities**

- Sustainable solutions for land, such as permaculture, precision agriculture, multi-story agroforestry systems and other sustainable farming practices, are already emerging. Such environmentally sound farming techniques will be further enhanced with frontier technologies building on future sensors and earth observations as well as AI-driven advice.
- Frontier technologies (such as drones) enable tracking vessels and fish stocks, even in remote areas with real-time reporting to enable dynamic management.
- Peer-to-peer markets can offer new market channels for local sustainably produced food.
- Regulation, supply chain management, technology, and greater social awareness massively reduce food loss and food waste. This transformative change would bring about less emissions from transport, ensure diversification of income sources and provide more equitable benefit sharing among food chain actors, while reducing widespread inequalities.

- Consumption preferences are changing towards locally and sustainably sourced food, including urban gardening and farming, reflecting a willingness of the public to embrace a paradigm shift from global commodity chains to local food production and sourcing.
- Consumers shift preferences towards a predominantly plant-based diet with greatly reduced content of food products usually produced in a "land degrading" manner including palm oil, beef, sugar, and processed white flour.
- Recent scientific findings from the IPCC SRCCL and SROCC underline the importance of changing the way we use land (including agricultural practices) and ocean.
- Sustainable win-win contract farming – to overcome scattered production; enterprises can be encouraged to invest in environmentally sound production.
- Education and awareness raising among stakeholders as a first step and a change in mindset.
- Scaling-up and out local solutions for sustainable food production.

IV. Challenges

- Coordination costs for food production at scale when it comes to smallholders, while challenges for them to access markets remain.
- Current large-scale agricultural systems drive food production to keep prices low. This has crowded out smallholders and led to a concentration of food production as well as decision-making power in the hands of big corporations. This heightens the risk of food insecurity and entrenches a status quo that stands in the way of change.
- Pesticide and seed corporations working on genetically modified seeds will try to promote them as the main way forward (also reducing genetic diversity of wildtypes traditionally used by small scale farmers).
- Small scale farmers are the backbone of the agricultural sector in developing countries but are rarely organized and lack capacity and resources to implement new technological solutions; there challenges of scaling-up of sustainable land management practices of smallholders.
- Access/co-creating appropriate technologies based on local conditions, resources, capacities – not to 'parachute' context-blind technologies.

V. Objectives to fulfil the vision

- Creating public support, incentives, tax-breaks for organic food production, avoiding to subsidize unsustainable food production and consumption, and designing governance frameworks for ensuring and mainstreaming regenerative food production, sustainable consumption, and sustainable land management.
- Identify and promote a mechanism for granting smallholder farmers, indigenous peoples and local communities' access to context-sensitive evolving frontier technologies, capacity-building and resources to implement regenerative agriculture solutions.
- Design inclusive governance systems as well as regulatory and policy frameworks support this vision by helping to overcome environmental and social challenges.

VI. Examples of possible activities mapped onto the objectives

- Setting up systems for collection and tailoring data services using frontier technologies, ensuring equitable access to relevant data and information by all, including by farmers, indigenous peoples and local communities – while ensuring that such information base is complemented with other types of knowledge (e.g. indigenous and local knowledge) relevant to galvanize regenerative agriculture.
- Conducting dialogues among technical, scientific and experiential knowledge as well as ILK holders (following FPIC principles) for equitable management of resources.
- Providing capacity building for farmers' to further adopt regenerative agriculture.
- Leveraging sustainable food production practices by creating/strengthening existing policies for inclusive land tenure security based on legal frameworks at national levels.
- Compiling and exchanging good practices of regenerative food production, while seeking opportunities to scale-up these practices.
- Awareness raising and capacity building to galvanize sustainable production of nutritious food.
- Setting up gene as well as seed banks and distribution systems that are accessible to all.

8. DEVELOPING TRANSFORMATIVE FINANCIAL INSTRUMENTS

I.   Vision

The financial system is transformed into a system that serves and supports a holistic understanding of thriving/value, including economic, social and environmental values and reciprocity, rooted in human wellbeing and healthy natural support systems.

II.   Rationale

The current global financial system amplifies uneven wealth accumulation, which widens income inequality, pushes growing numbers of people in poverty, and destroys ecosystem services.

III.   Opportunities

- The mounting pressure from global regulators on companies to disclose climate-related risks creates an opportunity to rethink the relationship between the financial system and natural systems, giving rise to new financial instruments that serve the transition to an inclusive, low-carbon, climate-resilient world. As investors wake up to the level of climate risk lurking in their portfolios, they will seek to deploy their capital in assets and through instruments that mitigate climate-related risks and instability.
- Rising concern about climate change, ecological collapse, and the degradation of our collective life support systems offer opportunities for governments at all levels to explore innovative approaches to catalyze behavior change grounded in environmental stewardship and local revitalization and resilience.
- Emerging technologies, including in the fintech space, hold potential to enable new forms, tracking and accounting of finance, and accelerate sustainable practices.
  Emergence of fintech enables pioneering countries, organizations, and other actors to begin experimenting with alternatives to traditional monetary units which would allow for inclusion of non-currency units in purchasing power parity (PPP) calculation.

IV.   Challenges

- The financial system is now predicated on an assumption of scarcity and debt, which require interest rate payments and facilitate perpetual economic growth.
- The financial system currently does not have consistent and comparative ways to account for ecosystem services, and ignores both the positive externalities supplied by nature and the negative externalities imposed upon nature.
- Finance and capital accumulation are often seen as ends in themselves, rather than means to an end (such as a positive environmental or social impact).
- A minority who have accumulated vast amounts of capital through this system functions as a powerful and vocal community of gatekeepers that uphold the status quo.
- Early movers who seek to depart from the status quo face significant risks and uncertain returns and are limited by lack of concepts and models for a finance system that facilitates sustainable wellbeing and an equitable global society rather than scarcity and exploitation.
- Smallholder farmers face challenges in access to finance. They are sometimes unable to even get a small loan to grow crops.
- Inflation and the abstract notion of wealth is related to inequality. Cryptocurrencies make this worse.

V.   Objectives to fulfil the vision

- Explore how a holistic understanding of thriving/value could work in practice, and identify entry points for moving towards this conceptualization and potential financial instruments compatible with this conceptualization. In particular, financial instruments should contribute to restoring and regenerating the local society, economy and ecosystem while simultaneously contributing to thriving on a global scale. This includes exploring how investment can be transformed from a profit-driven to a value-driven endeavor.
- Craft a new narrative and cultivate partnerships that demonstrate how financial instruments can enable frontier technologies to foster the (re-)development of circular economies and maintain regenerative natural systems, rather than relying on technology to substitute for ecosystem services.
- Promote financial tools to cultivate sustainable natural resource use and equitable resilience.
- Financial system cannot leave the masses behind. A socio-economic contract between the financial system and the rest of the masses should be made.
- There is tremendous inequality in wealth and finance in the world. The rich are getting richer and the poor are getting poorer. Consequently, in sustainability, we are trying to address the lack of balance not just in countries, but also in the distribution of wealth and finance.
- Rethink the value of money such as in the case of unpaid service work (looking after elderly relative example).

VI.   Examples of possible activities mapped onto the objectives

Education and awareness

- Redefine the idea of thriving/value for the Anthropocene and how that idea can be advanced by frontier technologies and new financial instruments and innovative ways for existing financial instruments to support the advancement of such technologies, including through establishing a working group composed of representatives of various UN agencies, academics, and private sector organizations.
- There are good examples in the context of resilience on transformative financial instruments. They need to be scaled up which is where the UN has a role to play- as one UN.

Policy and guidelines

- Identify seeds of positive change, i.e. pilot initiatives around the world that are compatible with the overarching vision and objectives. Gather knowledge about the enabling conditions that allowed the initiatives to emerge, share the lessons learned with relevant changemakers and subsequently develop guidelines. This should include alternative indicators to measure collective progress and wellbeing, such as happiness indices or wellness budgets; such an investigation should explore how these pilot initiatives can be refined or repurposed to align with the vision.
- Provide thought leadership in creating conversion metrics/methodologies/principles between traditional monetary units (currencies) and non-currency units.

- Mandatory disclosure requirement of GHGs in supply chain. Changing fiduciary responsibility of companies (towards its own shareholders) to also incorporating financial, social and environmental considerations (B Corps example).
- Make adaptation finance mirror the landscape of mitigation finance.
- Need a data regulator (akin to what the Banks have which is a global convention).
- The Data Digital strategy is the opportunity presented to create a regulatory environment that will protect and promote sustainability. Want this to become a de facto global standard like the General Data Protection Regulation. Need to think of how to influence the EU vision.
- Need a review mechanism for both public and private sectors to address AI accountability.
- Create UN data centers that are neutral, impartial and extraterritorial. Can include all public data sets like UNCTAD and other statistical environmental data sets.
- There is a role for third parties – evaluators or the proxy for them (overseeing agencies, auditors for example) to transform the financial landscape, if it is tied to the grant from donors.
- Small signal from insurance regulators triggered big change in the insurance industry. We can talk to the regulators for transforming the financial landscape.
- For getting the private sector firms, the bottom line is important. With the movement towards regular reporting of the Environmental Social Safeguards, there might be a role for regulators to encourage with incentives.