IEEE SA STANDARDS ASSOCIATION

IEEE planet positive 2030

Strong Sustainability by Design

PRIORITIZING ECOSYSTEM AND HUMAN FLOURISHING WITH TECHNOLOGY-BASED SOLUTIONS

FARMLANDS AND GRASSLANDS, MOUNTAINS AND PEATLANDS

An initiative supported by the IEEE Standards Association

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Strong Sustainability by Design

This Compendium has been created by committees of the IEEE Planet Positive 2030 Initiative supported by the IEEE Standards Association (IEEE SA). The IEEE Planet Positive 2030 Initiative community is composed of several hundred participants from six continents, who are thought leaders from academia, industry, civil society, policy and government in the related technical and humanistic disciplines. At least one hundred seventy members of this community from about thirty countries have contributed directly to this Compendium and have worked to identify and find consensus on timely issues.

The Compendium's purpose is to identify specific issues and recommendations regarding sustainability and climate change challenges to achieve "Planet Positivity" by 2030, defined as the process of transforming society and infrastructure by 2030 to:

- Reduce Greenhouse Gas (GHG) emissions to 50% of 2005 GHG emissions by 2030.
- Significantly increase regeneration and resilience of the Earth's ecosystems.
- Be well on the path to achieving net zero GHG emissions by 2050 and negative GHG emissions beyond 2050.
- Continue to widely deploy appropriate technology as well as design and implement new technological solutions in support of achieving technological solutions designed and deployed to achieve "Planet Positivity."

In identifying specific issues and pragmatic recommendations, the Compendium:

- Provides a scenario-based challenge (how to achieve "Planet Positivity by 2030") as a tool to inspire readers to get engaged.
- Advances a public discussion about how to build from a "Net Zero" mentality to a "Net or Planet Positive" ("do more good," that is, doing "more" than "don't harm") societal mandate for all technology and policy.
- Continues to build a diverse and inclusive community for the IEEE Planet Positive 2030 Initiative, prioritizing the voices of indigenous and marginalized members whose insights are acutely needed to help make technology and other solutions more valuable for all. Of keen interest is how to encourage more in-depth participatory design in these processes.
- Inspires the creation of technical solutions that can be developed into technical recommendations (for example IEEE SA recommended practice for addressing sustainability, environmental stewardship and climate change challenges in professional practice, IEEE P7800™) and associated certification programs.
- Facilitates the emergence of policies and recommendations that could potentially be intraoperative between different jurisdictions (e.g., countries).

By inviting the general public to read and utilize *Strong Sustainability by Design*, the IEEE Planet Positive 2030 community provides the opportunity to bring multiple voices from the related scientific and engineering communities together with the general public to identify and find broad consensus on technology to address pressing environmental and social issues and proposed recommendations regarding development, implementations and deployment of these technologies. You are invited to Join related IEEE activities, such as standards development and initiatives across the organization.

- For further information, learn more at the IEEE Planet Positive 2030 Initiative website
- Get in touch at: PlanetPositive2030@ieee.org to get connected to and engaged with the IEEE Planet Positive 2030 community.
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Strong Sustainability by Design was created in two versions ("draft" and this current edition) that were iterated over the course of two years. The IEEE Planet Positive 2030 Initiative follows a specific consensus building process where members contributing content identify specific potential issues and proposed recommendations.

Membership

IEEE Planet Positive 2030, an initiative supported by the IEEE Standards Association as part of the Industry Connections Program, Sustainable Infrastructures and Community Development program (SICDP), currently has more than four hundred experts involved, and remains eager for new voices and perspectives to join in this work.

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FARMLANDS AND GRASSLANDS, MOUNTAINS AND PEATLANDS

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While he is not on our committee, members would like to extend a special thanks to Steven Nitah, chief of the ŁútsëlK'é Dene First Nation, for providing a compass of the heart.

FARMLANDS AND GRASSLANDS, MOUNTAINS AND PEATLANDS

"We are one with nature. We are not above it or separate from it."

—Steven Nitah, chief of ŁútsëlK'é Dene First Nation

Future Vision

It is 2030.

Society has recognized and continues to recognize that the need to bring all humans together to care for the lands required immediate collective action/requires ongoing action. As U.S. environmentalist Paul Hawken said, "The first rule of sustainability is to align with natural forces, or at least not try to defy them."[1]

With support from the public, businesses, and governments, now in 2030, one-third of all farms have transitioned to regenerative agriculture practices. Societies no longer seek to exploit land for short-term profit but rather to better understand their role as healers of the land. Forests are recognized as life-sustaining ecosystems. Rather than cutting forests down, communities harvest only what the product/what they need. As a result, a significant boost in biodiversity has been measured across farmlands, forests, and the adjoining grasslands. People enjoy safe and tasty food grown in healthy, naturally regenerated soil. Soil carbon sequestration and the reduction of greenhouse gas (GHG) emissions have increased the overall value of the farms that made the transition. Furthermore, these farms have also reduced the costs of fuel and fertilizers, which have impacted the rest of the agricultural sector in the past decades. In 2030, ties have been established between the communities and land stewards, creating relationships that are co-caring versus transactional.

[1] Quote shared by Paul Hawken at a Real Organics Project online event on 22 April 2022.

Introduction

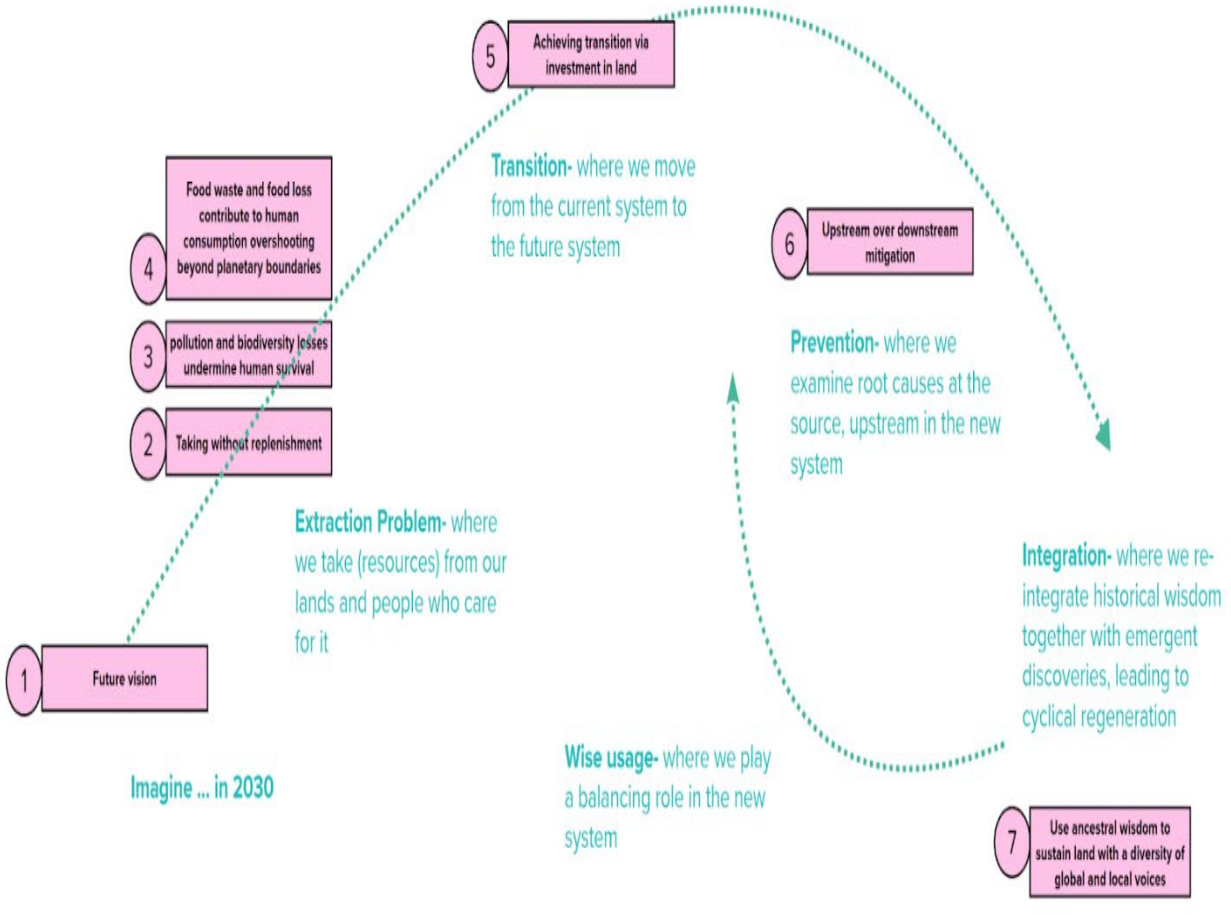

Figure 1: Structure of the Chapter in a Visual Format to Describe the Need for Integration and Reflection

Issue 1: Extraction—Taking without replenishment

Background

Changes in land use—deforestation, land clearing, mining, and depletion of freshwater resources—are a major driver of climate change and are often unsustainable. Plantation models persist in industrialized agriculture, leading to human labor exploitation (Gregor, 1962).

A high degree of correlation exists between resource aggregation into the hands of a few (consolidation of land and water rights) and human exploitation in terms of migrant wage labor, which has a direct impact on community health and economy, as follows (Hayes & Olmstead, 1984):

- Energy production relies on exploitation of resources that has left some areas inhabitable. Renewable energy production can have similar impacts on the environment (Sonter et al., 2020).
- Progress to safeguard key biodiversity areas has stalled during the last five years and without combined efforts in sustainable production, consumption and land use measures and the protection of key biodiversity areas, the loss of species will not turn around before 2050 (Whiting, 2022; Bingham et al., 2021).
- Invasive alien species have negatively affected native biodiversity, human health, and have cost the global economy billions of dollars annually (Rai & Singh, 2020).
- "Between 2015 and 2020, the rate of deforestation was estimated at 10 million hectares per year, down from 16 million hectares per year in the 1990s. The area of primary forest worldwide has decreased by over 80 million hectares since 1990" (UN FAO & UNEP, 2020).
- Climate and ecosystem change has been accelerated by unsustainable practices and has contributed to the increased prevalence and intensity of extreme weather events—such as droughts and floods—and of damaging invasive species—such as locusts—all of which are devastating to land stewards and farmers.
- An economically overdeveloped society has created unnecessary needs driving overconsumption. Gross domestic product (GDP) measures economic growth, which does not capture the complexity of the extractive models on which many societies have been based.
- The complexities behind intangible services have not been sufficiently questioned and, therefore, have not been resolved (e.g., software and cost on the environment).

Recommendations

1. **Set targets for soil carbon sequestration**:
    a. **Scale up and implement sustainable soil carbon sequestration practices** (Amelung et al., 2020)
    b. **Work toward valuation of natural capital** (EU, "Natural Capital Accounting")

2. **Support healthy and sustainable diets** (Willet et al., 2019):
    a. Reduce meat consumption and land clearing and deforestation linked to grazing
3. **Manage farms as systems**:
    a. Establish nitrogen and phosphate cycles as a system rather than within the boundaries of the farm only
4. **Lift the pressure of protein demand from animal raising**:
    a. Promote alternative proteins such as cultivated, plant-based, and fermented protein
    b. Encourage protein diversity for health and nutritional balance
    c. Liberate freshwater reservoir and arable pasture land for regenerative agricultural development
5. **Support technologies that provide alternatives to traditional farming products in restoration of biodiversity**:
    a. Replace animal leathers and wooden products with novel materials (e.g., fermentation-derived materials)
    b. Support research and development of cultivated meat in replacement of traditional animal meat
6. **Reduce the need for resources in the design phase of products to reduce or eliminate the need for extraction of resources**:
    a. Design for durability (e.g., long-lasting items)
    b. Design as a circular system (e.g., zero waste of resources and use materials in the loop)
    c. Design for modularity (easy to reuse or recycle parts)
    d. Design with interoperability (reduce the need to upgrade equipment or to have “proprietary” parts)
    e. Use low-tech materials
    f. Think “fixable and repairable” (including adopting behavior around maintaining rather than replacing)
    g. Design services or product-service systems rather than products
7. **Optimize the extraction processes:**
    a. Prepare graduating and practicing engineers to be knowledgeable about and understand the critical issues faced by land-based ecosystems—these issues are key drivers of the climate crisis.
    b. Decrease energy usage, and promote the usage of renewable energy.
    c. Look to additive manufacturing as a default process.
    d. Mine the waste streams (decades have been spent throwing away valuable materials that took energy and resources to mine and process).

8. **Support behavioral change to reduce the need for resources**:
    a. Maintain rather than replace.
    b. Be responsible owners and have respect for what individuals own or what people share.
    c. Consume less.
    d. Encourage a sharing economy.
    e. Avoid tragedy of the commons.
    f. Change advertisement guidelines to encourage sustainable lifestyle (e.g., fashion, energy, sharing, and repairing).

Further resources

1. Nishitani, Makiko, Martina Boese, and Helen Lee. "The Production of Precariousness and the Racialisation of Pacific Islanders in an Australian Horticultural Region." *Journal of Ethnic and Migration Studies* (Feb. 2023).
2. O'Connell, Daniel J., and Scott J. Peters. *In the Struggle: Scholars and the Fight Against Industrial Agribusiness in California*. New York: New Village Press, 2021.
3. Shamoon, Ahmad, Abid Haleem, Shashi Bahl, Mohd Javaid, Sonu Bala Garg, Rakesh Chandmal Sharma, and Jatinder Garg. "Environmental Impact of Energy Production and Extraction of Materials—A Review." *Materials Today: Proceedings* 57, pt. 2 (2022): 936–941.
4. Sun, Zhongxiao, Paul Behrens, Arnold Tukker, Martin Bruckner, and Laura Scherer. "Global Human Consumption Threatens Key Biodiversity Areas." *Environmental Science & Technology* 56 (May 2022): 9003–9014.

Issue 2: Extraction—Pollution and biodiversity losses undermine human survival

Background

Pollution, including from farming, reduces yields and food safety. Extraction from the land can leave dead zones, undermining current and future generations' ability to thrive. Climate change, population, and land use have profound impacts on the security of the global food supply chain (Molotoks et al., 2020; IPCC, 2019).

Farmlands (Boeraeve et al., 2020) and grasslands (Sun et al., 2022) are vital ecosystems. They supply food, fiber, and fodder and host countless organisms. However, degrading soil and vegetation, and excess agrochemicals and other pollutants deplete their vitality (Tilman, 1999; FoodPrint, "Food and the Environment").

Intensification of farmland is increasing. "Small farms (i.e., less than 2 ha) account for 84% of all farms worldwide; they operate on about 12 percent of all agricultural land but produce roughly 35% of the world's food" (UN FAO, *The State of the World's Forests 2022*, p. 78). "The largest 1% of farms (those larger than 50 ha) in the world operate more than 70% of the world's farmland" (Lowder, Sanchez, & Bertini, 2021).

Grasslands are one of the most widespread of all major vegetation types in the world. They occur in environments conducive to the growth of this plant cover but not that of taller plants (Smith, 2020). Ongoing degradation and the capacity to support biodiversity, ecosystem services, and human well-being place them under severe threat (Bardgett et al., 2021).

Policy decisions are often not anchored in research and may disregard long-term consequences for the environment, biodiversity, and people. Short-term goals were sometimes not questioned until it was too late to avoid negative impacts:

- Agricultural practices contribute to aquatic dead zones (Bailey et al., 2020) and negatively affect soil bacterial communities (Hhmelevtsova et al., 2022).
- Excessive tilling has been proven to cause soil erosion, but organic farms have been using light tillage for years to circulate organic matter back into the soil. There is a push in some developed countries to move farmers toward "no-till" practices. However, "no-till" outside of organic agriculture includes the termination of cover crops with herbicides, along with the continued use of synthetic fertilizers and pesticides (Real Organic Project, "Real Organic Symposium 2023").

Pollution is bad for both security and safety as it does the following:

Pollution affects supply, yield, and security:

- Ammonia, nitrogen (affecting soil)
- Ozone (reducing plants' ability to develop)
- "Black carbon (BC) is produced from incomplete combustion of biomass and fossil fuels and persists for centuries to millennia in the environment" (Coppola et al., 2022)

Pollution affects safety:

- "Forever chemicals" and "everywhere chemicals"
- Microplastics
- Pesticides
- Herbicides
- Fertilizers
- Runoff from animal waste
- Machinery (e.g., oil, gas, diesel, industrial lubricants, and coolants)

Recommendations

1. **Provide education to reach farmers, and co-design with them a shift from industrial agriculture models to regenerative agricultural models.**
2. **Offer incentives to allow the transition to regenerative farming practices**:
    a. Increase lands farmed organically by 25%
    b. Reduce pesticide use by 50%
    c. Reduce fertilizer use by 20%
    d. Reduce use of antibiotics for livestock use by 50%
    e. Create residue-free foods:
        i. Find non–oil-based alternatives to pesticide and fertilizers
3. **Provide funding for regenerative agricultural, conservation, and sustainable farming-related projects**:
    a. Secure funding for transition
    b. Use total cost of ownership over decades
4. **Offer tools for soil and water regeneration, solutions, frameworks, and markets for farmers**:
    a. Set targets for regenerative and organic content in institutional food programs
5. **Implement a cross-industry, closed-loop farming system**:
    a. Up-cycle waste from partnering food and beverage industries to use leftovers as fertilizer to reduce the need for, and costs of, chemical fertilizer
    b. Form a direct communication channel between farmers and retailers to exchange information about harvest conditions and market demand
    c. Implement limits on ground water use to preserve optimum water tables

6. **Organize responsibility at various levels for protecting the land that recognizes the land as nature rather than as industry. Hold these bodies accountable**:
    a. Define and use indicators other than GDP, which may be more appropriate indicators of a successful society
    b. Include long-term and future generations in decision-making processes
    c. Develop methods to anticipate consequences of decisions
    d. Find methods for staying calm in the face of problems that arise and for educating the public on the long-term benefits of change such as to reduce pollution and practice regenerative farming.

Case studies

This information is given solely for the convenience of users of this document as examples of case studies that were known at the time of publication, and does not constitute an endorsement of any company, product, service or organization by the IEEE or IEEE Standards Association (IEEE SA).

1. Air Pollution and Food Production

    UNECE Sustainable Development Goals. "Air Pollution and Food Production." UNECE, Environmental Policy, Air Pollution.

    "[Ammonia and nitrogen compounds affect] soil quality and thus the very capacity of the soil to sustain plant and animal productivity."

    "Ozone precursor emissions (nitrogen oxides and volatile organic compounds) are of particular concern for global food security as these compounds react to form ground-level ozone. This, in turn, penetrates into the plant structure and impairs its ability to develop. Ozone was estimated to cause relative global crop losses for soy 6-16%, wheat 7-12% and maize 3-5%. At a European level, a study in 2000 of the economic losses due to the impact of ozone on 23 crops amounted to 6.7 billion Euros."

2. Short-Lived Climate Pollutants and Food Security

    Climate & Clean Air Coalition. "Short-Lived Climate Pollutants and Food Security." About SLCPs, Benefits of Action, Food Security.

    "A warmer climate adds many challenges to food production. There is an increase in pests and diseases, and more frequent and extreme droughts and floods. Heat stress causes poor yields, or worse, crop failures. Together these impacts put pressure on domestic and global food systems and increase the likelihood of supply chain disruptions and competition for increasingly limited resources."

    "Air pollution stunts crop growth by weakening photosynthesis. Tropospheric ozone alone causes annual losses of approximately 110 million tonnes of major staple crops: wheat, rice, maize and soybean. This represents around 4% of the total annual global crop production, and up to 15% in some regions."

"Black carbon (a component of fine particulate matter or PM2.5) also harms crops when it covers their leaves, where it absorbs more sunlight and increases the plant's temperature. While in the atmosphere, black carbon affects plants by reducing the amount of sunlight that reaches the earth and disrupting rainfall patterns."

3. Special Report—Climate Change and Land

IPCC. Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems. P. R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H. -O. Pörtner, D. C. Roberts, P. Zhai et al., eds. In press. 2019.

"Four pillars of food security: availability, access, utilization, and stability"

"Observed climate change is already affecting food security through increasing temperatures, changing precipitation patterns, and greater frequency of some extreme events."

4. Roundup Lawsuit Update August 2022

Gaines, Mari. "Roundup Lawsuit Update." *Forbes Advisor,* updated 2 Feb. 2024.

"Studies have shown that the chemical might cause illness to humans and cause damage to the environment. The International Agency for Research on Cancer categorizes glyphosate as possibly carcinogenic to humans—essentially, the IARC is saying this toxin may cause cancer."

"A study from the University of Washington found that exposure to glyphosate increased an individual's risk of non-Hodgkin's lymphoma by 41%."

"The CDC recently released findings that up to 80% of Americans may have traces of Roundup in their urine, showing they have been exposed to it. Considering that 200 million pounds of Roundup are sprayed annually on U.S. crops, it is not surprising most of the population has been exposed to it."

5. Microplastics in Food

Alexis, Amber Charles. "What Do We Know About Microplastics in Food?" *Medical News Today*, 18 Feb. 2022.

"The microplastic chemicals present in food are a mixture of those that manufacturers deliberately add, such as fillers and stabilizers, and those that accumulate as byproducts, such as residues and impurities."

"Using eco-friendly packaging reduces Trusted Source the exposure to and migration of microplastics in the food supply."

Further resources

1. Hilimire, Kathleen, Sean Gillon, Blair C. McLaughlin, Brian Dowd-Uribe, and Kate L. Monsen. "Education Programs." *Agroecology and Sustainable Food Systems* 38, no. 6 (19 May 2014): 722–743.
2. Lindwall, Courtney. "Industrial Agriculture Pollution 101." NRDC. Updated 21 July 2022.
3. Ritchie, Hannah, Pablo Rosado, and Max Roser. "Environmental Impacts of Food Production." Our World In Data (online resource). 2022.
4. Smith, Jeremy M. B. "Grassland" in *Encyclopedia Britannica*, 13 Mar. 2020. Accessed 30 June 2022.
5. UN Environment Programme (UNEP) and the Food and Agriculture Organization (FAO) of the United Nations, UN Decade on Ecosystem Restoration. *Ecosystem Restoration Playbook: A Practical Guide to Healing the Planet*. Developed for World Environment Day 2021.

Issue 3: Extraction—Food waste and food loss contribute to human consumption overshooting beyond planetary boundaries

Background

As human consumption grows, immense pressure is placed on existing ecological safe havens, particularly rainforests, to yield to economic pressures. Transitioning from current to sustainable future systems means tackling food loss and food waste as a priority.

The need to feed 9 billion people by 2050 is pushing a rethink of the type of diets society/ies should adopt to operate within the capacity of the planet and to support a healthy population (Willett et al., 2019). Furthermore, food waste globally stands at more than 30%, representing a waste of 25% of all the water used by agriculture and 8% of global GHG emissions (Champions 12.3).

Current models in countries where sprawling suburbs encroach on arable lands, grasslands, and forests are not sustainable.

Recommendations

1. **Prioritize reduction of food loss.** Food loss and food waste mean that greater than 25% of all food produced globally is wasted before it reaches the people it needs to feed. Reducing food loss and food waste should help alleviate poverty, generate benefits for women, avoid agricultural expansion into natural ecosystems, reduce GHG emissions, and avoid depletion and/or pollution of aquifers (Goodwin, 2023).
2. **Severely limit the use of arable lands, grasslands, and forests for infrastructure builds, such as residences and industrial structures**.

Issue 4: Transition—Lack of investment in land sustainability

Background

Smallholder farmers lack access to capital, resources, stable markets, and general infrastructure to develop sustainable practices and build agro-economies. Transitioning to and scaling sustainable farming is fraught with challenges.

Farming is often inaccessible to new entrants who may have new ideas or more sustainable approaches. Smallholder farmers do not have the same level of access to technologies that boost productivity and crop resilience.

Smallholder farmers face the following economic challenges that can put their livelihood at risk:

- *Technology:* Many smallholder farmers do not have access to smartphone technologies, which makes it difficult to access markets for their agricultural produce.
- *Capital:* Traditional financial institutions may not be accessible to smallholder farmers, which can disable their ability to invest in more sustainable agricultural practices.
- *Markets:* Local and smallholder farmers often walk several kilometers to reach the market, carrying their produce. They can lose up to 40% of their harvest during the postharvest.
- *Capacity:* Most smallholder farmers across the developing world still practice subsistence farming versus sustainable agricultural practices (Alexander, 2020).
- As rural poverty increases, young people are driven into cities in search of employment, further deepening poverty cycles in the rural areas and increasing the difficulty of community revitalization.
- In some countries, “agriculture continues to be the main source of employment, livelihood, and income for between 50% to 90% of the population. Of this percentage, small farmers make up the majority, up to 70% to 95% of the farming population” (Kwa, 2021).

Transitioning farming practices is a risky business. For instance, how are the immediate cost hurdles addressed? Furthermore, climate change solutions are about scale, and smallholder farmers are a fragmented sector. Economic incentives are needed to encourage the shift to sustainable agriculture.

Food is produced within business models that may be incompatible with net-positive impacts and meaningful environmental, social, and corporate governance. Industrialized agriculture and shareholders are not incentivized to change practices, leading to a lack of scale in transitions. Consumers may have an illusion of choice when, in effect, 70% to 80% of grains are produced by only four companies globally and 60% of agricultural seeds and agricultural chemicals are produced by just three companies (Lakhani, Uteuova, & Chang, 2021). A change in the concentration of suppliers may be as, or more, important than changes made by individual consumers.

Recommendations

1. **Mobilize capital more efficiently by using surgical microfinance on subnational and community-based levels:**
    a. "Research from the *World Development Journal* found agricultural growth to have two to three times more impact on poverty reduction than equivalent growth in other industries" (Zamarelli, 2020)
    b. Community-based capital allocation can help remove intermediaries so that more resources go to farmers and land stewards.
    c. More capital in the hands of smallholder farmers can help de-risk their agribusiness and inspire innovation.
2. **Concentrate efforts to bridge the digital divide and alleviate energy poverty for smallholder farmers and rural agricultural communities by enabling technologies such as mobile phones, decentralized finance, and microgrids:**
    a. Giving smallholder farmers access to information about buyers and sellers through the internet can increase their revenues and reduce inefficiencies.
    b. Decentralized finance and peer-to-peer lending would decrease smallholder farmers' reliance on external (and sometimes misaligned) actors and unlock new avenues of sustainable agribusiness financing.
    c. Tapping into the abundant clean energy potential for smallholder farmers and providing reliable electricity access can serve as a foundation for other enabling technologies.
3. **Invest in human capital development for rural agrarian communities along with skills promotion and technology integration**:
    a. Given the opportunity, smallholder farmers can pursue sustainable farming practices and develop innovative methods.
    b. Increased human capital and training helps smallholder farmers de-risk their subsistence operations and could provide sufficient incentive to adopt more sustainable practices.
    c. Investing in human capital enables knowledge transfer within communities, across subsectors, and between generations.
    d. Helping smallholder farmers adapt to and integrate new technologies further reduces their reliance on external parties and induces exponential and network effects.
4. **Develop and enforce regulation for transition of farming practices for all types of farming to ultimately achieve sustainable farming with net-positive impacts and meaningful environmental, social, and corporate governance for the farming sector.**
5. **Incentivize the transition of farming practices to more regenerative sustainable farming models for industrialized agriculture and shareholders as well as smallholder farmers.**
6. **World agricultural seed and supply production should not be held by a small number of global monopolies.**
7. **Food production should be distributed around the globe and over a plethora of producers. This can improve diversity and help mitigate risks**.

Further resources

1. Harvey, Fiona. “Food Price Rises Around the World Are Result of ‘Broken’ System, Say Experts.” *The Guardian*, 24 Aug. 2022.

Issue 5: Environmental degradation—Upstream over downstream mitigation

Background

Environmental degradation and climate change have a far-reaching impact not only "on the land" but also on the landholders, the food supply system, the consumer, all the way to the insurance industry.

Consumers are often unaware of the impact their decisions have on land sustainability. The cost of environmental degradation is sometimes invisible to consumers, and they may be unaware of how their choices impact the environment. How do societies bring that to the center of consumers' everyday decisions? An extreme lack of transparency often exists regarding food systems.

The root causes of degradation should be examined at the source, upstream, in new systems and communicated within the entire food system. Transparency, traceability, and informed consumers could support high levels of prevention and mitigation to reduce negative impacts on lands before they happen.

Environmental degradation puts food production at risk, as do severe weather events. The insurance industry is well aware of the increased risks associated with food production. It requires oversight prior to any projects being initiated. With an increase in natural disasters, higher variability in local weather, and negative impacts on crop yields globally, the impacts of climate change in particular are generating large increases in insurance costs (Beam, 2023; Garthwaite, 2021) to the point where some areas are becoming uninsurable (Climate Council, 2022). The threat to agriculture risks undermining food security. Farmers can help build long-term resilience to climate change by changing farming practices, and the insurance industry can enable these efforts by supporting climate-smart projects.

In general, although cleaner production of goods of any kind and reduction of waste postproduction is increasingly being questioned, levels of consumption are rarely discussed. For example, consumers are told that they need to replace cars with fossil-fuel combustion engines with electric vehicles without contemplating the need to use cars at all or without considering the overall impact of producing and operating electric cars versus the lower overall GHG emissions. Information about such considerations is often lacking or, at a minimum, poorly communicated to the consumer.

Recommendations

1. **Identify the root causes of ecosystem degradation, and address the root causes; practice upstream mitigation.**
2. **Help consumers and purchasers become more well informed by providing easy access to information, communicating extensively and practicing transparency and traceability.**
3. **As a consumer, take responsibility.** Consumers are powerful:
    - Start small by asking where food comes from.
    - Consider shopping at a local farmers market if it is near.
    - Plan for healthy meals.
    - Try to reduce the amount of food waste.

- Research what labels such as "USDA Organic" really mean. What kind of production and distribution practices are used to produce organic food? For example, USDA Organic fruits and vegetables no longer need to grow in soil to be labeled organic.
- Protect the farming sector—large farming operations and small landholders—by providing appropriate insurance tools:
- To keep the farming community operating during times of increased risks, make protection through insurance available to cover against losses that could require resupplying of planting materials, loan reductions, and forgiveness. Provide yield-based insurance (One Acre Fund, 2022).

4. **Industries such as banking and insurance have a role to play in identifying the damage as they assess it prior to providing the green light for implementation or for funding**. **Iterative engagement with the insurance industry is needed to adapt the metrics used to approve or deny projects swiftly enough to capture the urgency of the challenges that are faced.** Many of the key tenets of *strong sustainability by design* defy easy measurement, and that ambiguity does not lend itself to actuarial modeling. **An iterative dialogue with insurance experts should enable an adaptive framework on which to build many of the solutions recommended in this chapter.**
5. **Support climate-smart agriculture** (World Bank Group, 2024).
6. **Consider friendshoring in the supply chain with like-minded communitie**s (Ellerbeck, 2023).
7. **Trade with regions and countries who support climate-friendly agriculture, ethical animal husbandry, and ethical and sustainable mining operations.**

Further resources

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Issue 6: Need for integration—Use ancestral wisdom to sustain land with a diversity of global and local voices

Background

The voices of Indigenous peoples and their ancestral wisdom have been sidelined in peoples/societies relationships with lands, resulting in further exploitation. Integrating historical wisdom together with emergent discoveries will lead to cyclical regeneration. Furthermore, the diversity of voices is not heard in techno-driven solutions. The tech approach to facing the challenges is at best human centered and does not include the voice of nonhumans, such as the environment (solutionism).

The digital divide and lack of access to communications technology has been a barrier to support food, land and water systems (Ng et al., 2021). Solutions are created and developed not from a place of "context" but from a place of "imagined empathy." (Morozov, 2014). Furthermore, technologies originating in the economically dominant global north should be promulgated respecting the traditions, history, and Indigenous viewpoints of adopting countries without necessarily reinforcing current power structure (Mohamed, Png, & Isaac, 2020).

- For centuries, Indigenous peoples have stewarded the land, sustainably providing for themselves and their communities for future generations: ranging from the Arctic tundra of the Inuit in Canada; the lush rainforest of the Manobo in the southern Philippines, or the desert of the Maasai in Kenya.
- Currently, Indigenous peoples only make up 5% of the world's population, yet they protect 85% of the world's biodiversity in forests, deserts, grasslands, and marine environments (Hawken, 2021).
- Unfortunately, the effects of colonization have marginalized Indigenous peoples, systemically silencing and oppressing these groups from participation in governance and stewardship of the land. In extreme cases, this marginalization has led to genocide; today, the effects linger as generational trauma through displacement, loss of culture, values, and ultimately a fractured relationship with the land that was once stewarded by their peoples.

Recommendations

1. **Learn the history of the lands that are lived and worked on:**
    a. If on colonized lands, recognize that societies have historically benefited and continue to benefit from the ongoing colonization of Indigenous peoples.
    b. If not on colonized lands, recognize the Indigenous peoples whose traditional livelihoods and stewardship of land may be threatened by the interests of the nation-state or corporations.
    c. Consult histories written, spoken, and performed by Indigenous authors.
2. **Work toward decolonization by amplifying and supporting Indigenous peoples**:
    a. Respect Indigenous leadership and sovereignty.
    b. Build meaningful alliances and collaborations with respective Indigenous peoples.

c. Conduct business with Indigenous-owned businesses when possible.

3. **Implement the United Nations Declaration on the Rights of Indigenous Peopl**e (UNDRIP).
4. **Include a diversity of voices in decision making so that solutions are developed from a point of "context."** The techno-driven solutions approach to facing the challenges is at best human centered and does not include the voice of nonhumans, such as the environment.
5. **Promulgate technologies originating in the economically dominant global north to respect the traditions, history, and Indigenous viewpoints of adopting countries.**
6. **Overcome and address the digital divide to provide communications technology in support of food, land, and water systems**.

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