IEEE SA STANDARDS ASSOCIATION

planet positive 2030

Strong Sustainability by Design

FARMLANDS AND GRASSLANDS, MOUNTAINS AND PEATLANDS

An initiative supported by the IEEE Standards Association

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Strong Sustainability by Design - Version 1 (Draft)

Request for Input

Public comments are invited on the first version of ***Strong Sustainability by Design: Prioritizing ecosystem and human flourishing with technology-based solutions*** that identifies specific issues and pragmatic recommendations regarding sustainability and climate change to achieve "Planet Positivity" by 2030.

This draft compendium has been created by committees of the Planet Positive 2030 Initiative[1] that is supported by IEEE Standards Association (IEEE SA). The 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 fifty members of this community have contributed directly and have worked to identify and find consensus on timely issues.

The document's purpose is to identify specific issues and candidate 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 emissions by 2030[2]
- Significantly increase regeneration and resilience of earth's ecosystems[3]
- Be well on the path to achieving net zero GHG emissions by 2050 and negative GHG emissions beyond 2050
- Continue to widely deploy 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 document:

- Provides a scenario-based challenge (how to achieve "Planet Positivity by 2030") as a tool to inspire readers to provide contextual technical and general feedback as part of this RFI.
- Advances a public discussion about how to build from a "Net Zero" mentality to a "Net or Planet Positive" ("do more good") societal mandate for all technology and policy.
- Continues to build a diverse and inclusive community for the Planet Positive 2030 Initiative, prioritizing the voices of Indigenous and marginalized members whose insights are acutely needed to help ensure technology and other solutions are valuable for all. Of keen interest is how we can encourage more in-depth participatory design in our processes.
- Inspires the creation of technical solutions that can be developed into technical standards (IEEE Standards Association, for example ICT and power & energy related standards, IEEE P7800™ series) and associated certification programs.
- Facilitates the emergence of policies and regulations; regulations that would potentially be interoperative between different jurisdictions (countries).

[1] Planet Positive 2030is part of The Sustainable Infrastructures and Community Development Industry Connections program

[2] As described in the United Nations Climate Change Conference (COP 21) Paris Agreement of 2015.

[3] According to the High Ambition Coalition for Nature and People, "In order to address both the biodiversity crisis and the climate crisis, there is growing scientific research that half of the planet must be kept in a natural state….experts agree that a scientifically credible and necessary interim goal is to achieve a minimum of 30% protection by 2030." Protection for land and water of "30 x 30 by 2030" was recommended during COP15 United Nations Convention on Biological Diversity.

By inviting comments for *Strong Sustainability by Design*, the Planet Positive 2030 community provides the opportunity to bring together multiple voices from the related scientific and engineering communities 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.

Details on how to submit public comments are available in the **Submission Guidelines**.

Comments in response to this request for input will be considered by the Planet Positive 2030 Initiative committees for potential inclusion in the first public edition of *Strong Sustainability by Design* ("*Strong Sustainability by Design*, First Edition") anticipated to be made available to the general public during the fourth quarter of 2023.

- For further information, learn more at the Planet Positive 2030 Initiative website.
- For our Frequently Asked Questions (beyond RFI submission), please click here.
- Get in touch at: PlanetPositive2030@ieee.org to get connected to a committee or any other reason.
- Please, subscribe to our newsletter here.

If you're a journalist and would like to know more about the Planet Positive 2030 Initiative, please contact: Standards-pr@ieee.org

Disclaimers

Strong Sustainability by Design is not a code of conduct or a professional code of ethics. Engineers and technologists have well-established codes, and we wish to respectfully recognize the formative precedents surrounding issues of sustainability and the professional values these codes represent. These codes provide the broad framework for the more focused domain addressed in this document, and it is our hope that the inclusive, consensus-building process around its design will contribute unique value to technologists and society as a whole.

This document is also not a position, or policy statement, or formal report of IEEE or any other organization with which is affiliated. It is intended to be a working reference tool created in an inclusive process by those in the relevant scientific and engineering communities prioritizing sustainability considerations in their work.

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A Note Regarding Recommendations in This Document

Strong Sustainability by Design is being created via multiple versions that are being iterated over the course of two to three years. Planet Positive2030 is following a specific concurrence-building process where members contributing content are proposing “candidate” recommendations so as not to imply these are final recommendations at this time. This is also why the word, “Draft” is so prominently displayed.

Our Membership

Planet Positive2030, 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 400 experts involved in our work, and we are eager for new voices and perspectives to join our work.

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Farmlands and Grasslands, Mountains and Peatlands - Table of Contents

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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 the need to bring all humans together to care for our lands that required immediate collective action. As U.S. environmentalist Paul Hawken said of addressing our climate emergency, "The impotence of individual actions is exactly the reason for everyone to try."[4]

Emboldened by support from the public, businesses, and governments, now in 2030, we have a world in which one-third of all farms have transitioned to regenerative agriculture practices. We no longer seek to exploit land for short-term profit but to better understand our role as healers of the land. Forests are recognized as life-sustaining ecosystems. Rather than cutting them down, we harvest only what we 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 avoided the cost of fuel and fertilizers, which has plagued the rest of the agricultural sector in the last decade. In 2030, we have established ties between our community and land stewards, creating relationships that are co-caring versus transactional.

[4] Quote shared by Paul Hawken at a Real Organics Project online event on 22 April 2022. Hawken is an environmental leader, and author of the books *Drawdown* and *Regeneration*. More information about Paul Hawken is found at: https://paulhawken.com.

Issue: 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 unsustainable. Plantation models persist in industrialized agriculture, leading to human labor exploitation.[5] We take from the land and from the people who care for it.

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:[6]

- Energy production relies on exploitation of resources that has left areas inhabitable. Renewable energy production has similar impacts on the environment[7].
- 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[8,9].
- Invasive alien species have negatively affected native biodiversity and have cost the global economy billions of dollars annually[10].
- 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[11].
- 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 model our societies have been based on.

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[5] Howard F. Gregor, "The Plantation in California." *The Professional Geographer* 14, no. 2 (Mar. 1962), https://www.tandfonline.com/doi/abs/10.1111/j.0033-0124.1962.142_1.x.

[6] Michael N. Hayes and Alan L. Olmstead, "Farm Size and Community Quality: Arvin and Dinuba Revisited," *American Journal of Agricultural Economics* 66, no. 4 (Nov. 1984): 430–436, https://www.jstor.org/stable/1240921.

[7] L. J. Sonter, M. C. Dade, J. E. M. Watson, et al. "Renewable Energy Production Will Exacerbate Mining Threats to Biodiversity," *Nat. Commun.* 11, 4174 (2020), https://doi.org/10.1038/s41467-020-17928-5.

[8] "6 Charts that Show the State of Biodiversity and Nature Loss—And How We Can Go 'Nature Positive'," World Economic Forum, 17 Oct. 2022, https://www.weforum.org/agenda/2022/10/nature-loss-biodiversity-wwf/.

[9] Protected Planet Report 2020, https://livereport.protectedplanet.net/.

[10] Prabhat Kumar Rai and J. S. Singh, "Invasive Alien Plant Species: Their Impact on Environment, Ecosystem Services and Human Health." *Ecological Indicators* 111 (Apr. 2020), https://doi.org/10.1016/j.ecolind.2019.106020.

[11] UN Food and Agriculture Organization (FAO) and UN Environment Programme, *The State of the World's Forests 2020: Forests, Biodiversity and People* (Rome: FAO, 2020), https://doi.org/10.4060/ca8642en.

- The complexity behind intangible services has not been questioned and, therefore, has 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[12]

   b. Work toward valuation of natural capital[13]

2. Support healthy and sustainable diets:
   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 to ensure 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)

[12] Amelung, W., Bossio, D., de Vries, W., Kögel-Knabner, I., Lehmann, J., Amundson, R., Bol, R., Collins, C., Lal, R., Leifeld, J., Minasny, B., Pan, G., Paustian, K., Rumpel, C., Sanderman, J., van Groenigen, J. W., Mooney, S., van Wesemael, B., Wander, M., & Chabbi, A. (2020, October 27). *Towards a global-scale soil climate mitigation strategy*. Nature News. https://www.nature.com/articles/s41467-020-18887-7

[13] European Union. (2022, July 11). *Natural Capital Accounting*. Natural capital accounting. https://environment.ec.europa.eu/topics/nature-and-biodiversity/natural-capital-accounting_en

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 process:
   a. Decrease energy usage, and ensure renewable energy is used

   b. Look to additive manufacturing as a default process

   c. Mine our waste (e.g., decades have been spent throwing away valuable materials that took a lot of energy and resources to mine and process in the first place)

8. Support behavioral change to reduce the need for resources:
   a. Maintain rather than replace

   b. Be responsible owners and have respect for what we own or what we share

   c. Consume less

   d. Encourage a sharing economy

   e. Avoid tragedy of the commons

   f. Change advertisement to encourage sustainable lifestyle (e.g., fashion, energy, sharing, and repairing via legislation)

Technological Insights and Recommendations

This space is intentionally left blank to encourage technically oriented feedback for public Request for Input.

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." *Environ. Sci. Technol.* 56 (May 2022): 9003–9014.

Issue: Extraction: Pollution and biodiversity losses undermine human survival

Background

Pollution, including from farming, reduces yields and food safety. We extract from the land and 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[14][15].

Farmlands[16] and grasslands[17] 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[18,19].

Intensification of farmland is increasing. Small farms (less than 2 ha) account for 84% of all farms worldwide but operate only around 12% of all agricultural land and produce approximately 35% of the world's food. The largest 1% of farms (those larger than 50 ha) operate more than 70% of the world's farmland[20].

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[21]. Ongoing degradation and the capacity to support biodiversity, ecosystem services, and human well-being place them under severe threat[22].

Political decisions are often not anchored in research and with disregard for the long-term consequences on the environment, biodiversity, and people. Short-term goals for ego-driven politicians were not questioned for more than 60 years until it was too late to revert the following negative impacts:

- Agricultural practices contribute to aquatic dead zones[23] and negatively affect soil bacterial communities[24]

[14] A. Molotoks, P. Smith, and T. P. Dawson, "Impacts of Land Use, Population, and Climate Change on Global Food Security," *Food and Energy Security10*, no. 1 (Nov. 2020), https://doi.org/10.1002/fes3.261.

[15] P. R. Shukla et al., *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* (Rome: IPCC, 2019).

[16] F. Boeraeve, N. Dendoncker, J. T. Cornélis, F. Degrune, and M. Dufrêne, "Contribution of Agroecological Farming Systems to the Delivery of Ecosystem Services," *Journal of Environmental Management* 260 (Apr. 2020), https://doi.org/10.1016/j.jenvman.2019.109576.

[17] J. Sun et al., "Toward a Sustainable Grassland Ecosystem Worldwide," *Innovation* 3, no. 4 (May 2022), 10.1016/j.xinn.2022.100265.

[18] Tilman, D. "Global Environmental Impacts of Agricultural Expansion: The Need for Sustainable and Efficient Practices," *Proceedings of the National Academy of Sciences* 96, no. 11 (May 1999): 5995–6000, https://doi.org/10.1073/pnas.96.11.5995.

[19] FoodPrint (website). "Food and the Environment." *Project of GRACE Communications Foundation*.

[20] Sarah K. Lowder, Marco V. Sánchez, and Raffaele Bertini, "Which Farms Feed the World and Has Farmland Become More Concentrated?" *World Development* 142 (June 2021), https://doi.org/10.1016/j.worlddev.2021.105455.

[21] Jeremy M. B. Smith, "Grassland," in *Encyclopedia Britannica*, 13 Mar. 2020, https://www.britannica.com/science/grassland, accessed 30 June 2022.

[22] R. Bardgett et al., "Combatting Global Grassland Degradation," *Nature Reviews Earth & Environment* 2, no. 10 (Sept. 2021): 720–735, https://doi.org/10.1038/s43017-021-00207-2.

[23] A. Bailey, L. Meyer, N. Pettingell, M. Macie, and J. Korstad, "Agricultural Practices Contributing to Aquatic Dead Zones," *ological and Practical Applications for Sustainable Agriculture* (June 2020): 373–393, 10.1007/978-981-15-3372-3_17.

- Excessive tilling has been proven to cause soil erosion, but it is important to note that organic farms have been using light tillage for years to circulate organic matter back into the soil. There is a dogmatic push in the US particularly to move all 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. (Source: https://www.realorganicsymposium.org/, Real Organics Symposium 2023)

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

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[25] (covers leaves—heats up plants and prevents photosynthesis)

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:
   a. Consider friend shoring in the supply chain with like-minded communities
2. Offer incentives to allow this transition:
   a. Increase lands farmed organically by 25%

[24] Ludmila Eugenevna Hhmelevtsova, Ivan Sergeevich Sazykin, Tatiana Nikolaevna Azhogina, and Marina Alexandrovna Sazykina, "Influence of Agricultural Practices on Bacterial Community of Cultivated Soils" *Agriculture* 12, no. 3 (Mar. 20222): 371, https://doi.org/10.3390/agriculture12030371.

[25] Coppola, A.I., Wagner, S., Lennartz, S.T. et al. The black carbon cycle and its role in the Earth system. Nat Rev Earth Environ 3, 516–532 (2022). https://doi.org/10.1038/s43017-022-00316-6

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:
    1. 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 water tables

6. Organize a committee in government responsible for protecting the land and supported by law that recognizes the land as nature rather than as industry:
    a. Define indicators other than GDP, which may be more appropriate indicators

    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

Technological Insights and Recommendations

This space is intentionally left blank to encourage technically oriented feedback for public Request for Input.

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. for *Encyclopedia Britannica Online.* "Grassland," accessed 30 June 2022.
5. UN Environment Programme and the Food and Agriculture Organization 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.

Case Studies

1. Air pollution and food production
   https://unece.org/air-pollution-and-food-production
   "[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
   https://www.ccacoalition.org/en/content/short-lived-climate-pollutants-and-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
   https://www.ipcc.ch/srccl
   "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
   https://www.forbes.com/advisor/legal/product-liability/roundup-lawsuit-update
   "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. What do we know about microplastics in food?
   https://www.medicalnewstoday.com/articles/what-do-we-know-about-microplastics-in-food
   "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."

Issue: 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 7 billion people by 2050 is pushing a rethink of the type of diets we should adopt to operate within the capacity of the planet and to support a healthy population[26]. 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[27].

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

Recommendations

Food waste and food loss 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 would help alleviate poverty, generate benefits for women, avoid agricultural expansion into natural ecosystems, reduce GHG emissions, and not deplete or pollute aquifers[28].

Technological Insights and Recommendations

This space is intentionally left blank to encourage technically oriented feedback for public Request for Input.

[26] Willett, Dr. Walter, Johan Rockström, Brent Loken, Marco Springmann, Tim Lang, Sonja Vermeulen, Tara Garnett, et al. "Food in the Anthropocene: The EAT-Lancet Commission on Healthy Diets from Sustainable Food Systems." The Lancet 393, art. 10170 (2 Feb. 2019): 447–492.

[27] Champions 12.3. (2023, May 30). Champions 12.3.https://champions123.org/

[28] Goodwin, L. (2023, April 20). The global benefits of reducing food loss and waste. World Resources Institute. https://www.wri.org/insights/reducing-food-loss-and-food-waste

Issue: How to achieve transition via 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 (dominated by industrial interests) is incredibly inaccessible to new entrants who may have new ideas/more sustainable approaches. Smallholder farmers do not have the same level of access to technologies that boost productivity and crop resilience.

In many countries, smallholder farmers lack access to capital, resources, stable markets, and general infrastructure to develop sustainable practices, support livelihoods, and build agro-economies. They face the following economic challenges that put their livelihood and existence at risk:

- *Technology:* 90% of the smallholder farmers do not have access to smartphones, and it makes it difficult to access markets for their agricultural produce.
- *Capital:* Traditional financial institutions do not trust smallholder farmers, which disables their ability to invest in more sustainable agricultural practices.
- *Markets:* Local and smallholder farmers must often walk from 8 km to 10 km to reach the market, and they mostly carry their produce on their heads. They 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[29].
- 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 50% to 90% of the population. Of this percentage, small farmers make up the majority, as much as 70% to 95% of the farming population[30].

Transitioning farming practices is a risky business. For instance, how do we address the immediate cost hurdles? 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 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 have an illusion of choice

[29] Alexander, L. (2020, March 25). Sustainable farming in developing countries. The Borgen Project. https://borgenproject.org/sustainable-farming-in-developing-countries/

[30] Kwa, A. (2001, June). Agriculture in Developing Countries: Which Way Forward?. Agriculture in developing countries: Which way forward? https://www.iatp.org/sites/default/files/Agriculture_in_Developing_Countries_Which_Way_.htm

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[31]. A change in the concentration of suppliers is as, or more, important than a change made by individual consumers.

Recommendations

1. Mobilize capital more efficiently by using surgical microfinance on sub national 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.

    b. Community-based capital allocation would remove intermediaries and ensure that more resources go to farmers and land stewards.

    c. More capital in the hands of smallholder farmers de-risks their agribusiness and inspires 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 would exponentially 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.

[31] Lakhani, N. L., Uteuova, A., & Chang, A. (2021, July 18). The illusion of choice: Five stats that expose America's Food Monopoly Crisis. The Guardian. https://www.theguardian.com/environment/2021/jul/18/america-food-monopoly-crisis-grocery-stores

Technological Insights and Recommendations

This space is intentionally left blank to encourage technically oriented feedback for public Request for Input.

Further resources

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

2. Kwa, Eileen. *Agriculture in Developing Countries: Which Way Forward?* Trade-Related Agenda, Development, and Equity (T.R.A.D.E.). Occasional Papers 4. June 2001.

3. Zamarelli, Dan. "Sustainable Farming in Developing Countries." *The Borgen Project* (blog). *Latest News.* 29 Mar. 2020.

Issue: Upstream over downstream mitigation

Background

Consumers are unaware of the impact their decisions have on land sustainability. Root causes should be examined at the source, upstream, in new systems. Transparency, traceability, and informed consumers could support high levels of prevention and mitigation to reduce negative impacts on lands before they happen.

The cost of environmental degradation is invisible to consumers, and they are unaware of how their choices impact it. How do we bring that to the center of consumers' everyday decisions? An extreme lack of transparency exists regarding food systems.

Although cleaner production and reduction of waste post-production is increasingly being questioned, levels of consumption are rarely discussed. For example, we are told that we need to replace our cars with electric ones without contemplating the need to use cars at all or without considering the overall increase in human toxicity of producing electric cars versus the lower overall GHG emissions. Such considerations highly affect land use and human health.

Recommendations

- Consumers are more powerful than we think. Start small by asking where your food comes from. Consider shopping at a local farmers market if you are near one.

- Research what labels such as USDA Organic really mean. What kind of production and distribution practices are used to produce your food? For example, did you know that USDA Organic fruits and vegetables no longer need to grow in soil to be labeled organic? (Source: https://www.realorganicproject.org/?s=hydroponic)

Technological Insights and Recommendations

This space is intentionally left blank to encourage technically oriented feedback for public Request for Input.

Further resources

1. Verma, Shrey, Gaurav Dwivedi, and Puneet Verma. "Life Cycle Assessment of Electric Vehicles in Comparison to Combustion Engine Vehicles: A Review." *Materials Today: Proceedings* 49, pt. 2 (2022): 217–222.

2. Alliance for Science: (Consumers unaware)

Issue: Need for integration to 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 our 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).

Digital Divide and lack of access to communications technology has been a barrier to support food, land and water systems[32]. Solutions are created and developed not from a place of "context" but from a place of "imagined empathy"[33]. 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[34].

- 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. (From Paul Hawken's Regeneration)

- 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 you live and work on:
    a. If you are on colonized lands, such as in the United States, recognize that your country has historically benefited and continues to benefit from the ongoing colonization of Indigenous peoples.

    b. If you are not on colonized lands, recognize the Indigenous peoples of your country 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.

[32] Ng M; de Haan N; King B; Langan S. 2021. Promoting inclusivity and equity in information and communications technology for food, land, and water systems. CGIAR Platform for Big Data in Agriculture, Cali Colombia

[33] Morozov, E. (2014). To save everything, click here: The folly of technological solutionism. Public Affairs.

[34] Mohamed et al (2020) Decolonial AI: Decolonial theory as sociotechnical foresight in artificial intelligence, Philosophy and Technology

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 People (UNDRIP).

Technological Insights and Recommendations

This space is intentionally left blank to encourage technically oriented feedback for public Request for Input.

Further resources

1. The Anti-Oppression Network (website). "Allyship."

2. Jones, Benji. "Indigenous People Are the World's Biggest Conservationists, But They Rarely Get Credit for It," *Vox.* 11 June 2021.

3. Kimmerer, Robin Wall. *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teaching of Plants*. Minneapolis, MN: Milkweed Editions. 2013.

4. UN General Assembly, Resolution 61/295, *Declaration on the Rights of Indigenous Peoples*, A/RES/61/295. 13 Sept. 2007.

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