PILLARS 2 & 3

SUSTAINABLE OPERATIONS & VALUE CHAINS

5

AGROCHEMICALS & SUSTAINABLE AGRICULTURE

STANDARD

Tractor spraying pesticides on a vegetable field.

Commitment

Minimize agrochemical use in the value chain and support producers in transitioning to sustainable and regenerative agricultural practices that maintain productivity while protecting ecosystems and human health and preserving soil and other natural resources.

Aligning a company's practices with the SDGs entails ensuring that current agricultural productivity does not compromise that of future generations. However, many of the common food production practices that support increased productivity in the short term have negative impacts that undermine the achievement of the SDGs and jeopardize long-term environmental and agricultural resilience. Chief among these is the use of agrochemicals and intensive agricultural practices that damage ecosystems and degrade soil and natural resources.

Collectively, the world has not been able to meet intermediate targets and has fallen below the trajectory necessary to meet the SDGs related to the responsible utilization of agrochemicals and mitigation of their adverse impacts.[1] The use of agrochemicals, including fertilizers, pesticides (also referred to as "plant protection products"), and antimicrobials (e.g., livestock antibiotics), has deleterious effects on people and the planet. Unfortunately, the majority of agrochemicals, in large part due to their non-discriminatory and widespread use, do not perform as intended. An estimated 95 to 99.9% of pesticides applied, for example, do not reach their target objects (i.e., the actual pests they are intended for),[2] and it is estimated that 75 to 90% of antimicrobials are excreted by livestock unmetabolized.[3] The resulting runoff, leaching, and other deposition of these chemicals into ecosystems have dire environmental effects, including water supply contamination, creation of hypoxic ocean zones, greenhouse gas emissions, biodiversity loss (e.g., disruption of species reproduction, pollinator population reductions), and soil degradation.[4]

Agrochemical use can also have dire consequences on human health. Pesticide intoxication kills hundreds of thousands of people per year[5] and damages the health of millions,[6] particularly in developing countries where regulations and safety precautions are less stringent and toxic agrochemicals that are banned in more developed countries are still used.[7] Additionally, while further research is needed, large-scale epidemiological findings suggest consuming conventionally grown foods results in greater incidences of cancer compared to diets comprised mainly of foods grown without synthetic pesticides.[8] Excessive use of antimicrobials among livestock and food-producing animals, especially prophylactically for non-therapeutic reasons such as growth-promotion, has also created increasing concern of antimicrobial resistance and its large public health implications (e.g., pandemics).[9]

While the overuse of agrochemicals and intensive planting and harvesting practices currently provide some benefits with regards to yields and risk mitigation, they pose long-term threats to the productivity and security of global food systems through the disruption of natural ecosystem services (e.g., pollination by invertebrates), soil degradation and loss, resistance and the need to use ever-increasing quantities to realize the same effects, and other consequences. Indeed, continuing current agricultural practices and the heavy use of agrochemicals is predicted to render them increasingly ineffective, cause an increased risk of crop failures and livestock diseases, decrease productivity, threaten global food security, and impose greater financial risk and burden for producers.[10]

Indeed, the future of global food systems is dependent on the perpetuity of the natural resources that support agriculture and food production. Of utmost concern is soil health, which determines "the ability of the soil to sustain the productivity, diversity, and environmental services,"[11] including agriculture and food production both now and for future generations. Soil is a nonrenewable resource,[a] and its loss poses a major threat to global food security and achievement of the SDGs, especially SDG 2 concerning global hunger.[12] Soil is essential for land-based agriculture and a dynamic, interdependent ecosystem in itself that relies on complex relationships between microbes, plants, and animals to maintain fertility. Globally, soil erosion is accelerating, and intensive agricultural practices (e.g., tilling, application of agrochemicals, monoculture cultivation, and leaving fields fallow) have not only greatly reduced the sheer volume of soil available for food production but also its fertility. Estimates suggest more than one-third of all arable soil has been degraded and, at the current rates of loss and degradation, 90% of soils could be unsuitable for agriculture by 2050.[13]

Fortunately, alternatives to intensive agricultural practices exist, including those that promote more judicious and precise application of agrochemicals, that provide natural pest and pathogen protection while protecting human and environmental health, that preserve soil, and that render food systems more resilient and stable. Amongst these are agroecological approaches and other options that partially or entirely replace agrochemicals and may enhance natural resources and ecosystem health, including organic or biological[b] pest controls,[14] integrated pest management (IPM) approaches,[c] cover cropping, crop rotation, perennial cultivation, tilling reduction, or elimination, and managed grazing.[15]

However, the feasibility of and pathways towards agroecology and sustainable agricultural systems are still contested, and agriculture is intimately tied to social and economic concerns. Complete or rushed transitions of agricultural practices could prove counterproductive, threatening global food security and safety, disproportionately disadvantaging those already vulnerable to food insecurity and hunger, and putting the livelihoods of producers, especially smallholder producers,[d] at risk.[16] For this reason, as well as the nuanced challenges of feeding a global population of nearly 10 billion by 2050[17] without significantly growing agriculture's footprint, it may be imperative to transition to alternative practices judiciously, employing qualified experts, producers themselves (who are experts on their land and activities), and other stakeholders to determine suitable transition plans and trajectories that help maintain productivity and livelihoods while minimizing synthetic inputs and their environmental and human health impacts.

As food companies depend on stable and secure value chains, they have a critical role to play in ensuring the long-term sustainability of global food systems through supporting the transformation of production practices, reduction of agrochemical use, and promotion of healthy soil and agricultural lands. Processing companies can support producers in the transition — balancing their productivity needs with the imperative to reduce their agrochemical use and to adopt sustainable agricultural practices to align with the SDGs.

a. While soil is technically constantly being formed through natural processes, it takes an estimated 1,000 years to create 2-3 cm and restoring lost topsoil is infeasible within several lifetimes; for the purposes of food security in the near future and this standard, soil is thus considered a "nonrenewable resource." (Source: FAO, "Key Messages," Global Symposium on Soil Erosion, accessed June 17, 2021, http://www.fao.org/about/meetings/soil-erosion-symposium/key-messages/en/.)

b. Microbial pesticides are bacteria or fungi that target specific pests. Parasitic insects are natural predators of target pests. Use of both biological control options aim to kill target pests without harm to pollinators and other ecosystem aspects. Pheromones are molecules that confuse target pests, preventing them from reproducing or deterring them from certain areas. Importantly, these pest control strategies may have greater specificity for their target pests and, thus, preserve biodiversity. (Source: "Biological 'Green' Alternatives to Chemical Pesticides : USDA ARS," accessed June 1, 2021, https://www.ars.usda.gov/oc/utm/biological-green-alternatives-to-chemical-pesticides/.)

c. Integrated Pest Management (IPM) involves "the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human and animal health and/or the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms." (Source: Inter-Organization Programme for the Sound Management of Chemicals, WHO, and FAO, eds., *The International Code of Conduct on Pesticide Management* (Rome: Inter-Organization Programme for the Sound Management of Chemicals : World Health Organization : Food and Agriculture Organization of the United Nations, 2014).)

d. This standard acknowledges the complex challenge of transforming global food systems in ways that are safe, equitable, and feasible. Eliminating agrochemicals or forcing transitions too quickly could prove counterproductive and put producers', especially smallholders', livelihoods at risk due to the current state of widespread agrochemical dependence as well as threaten the stability of global food security and stability. (Source: József Popp, Károly Pető, and János Nagy, "Pesticide Productivity and Food Security. A Review," *Agronomy for Sustainable Development* 33, no. 1 (January 1, 2013): 243–55, https://doi.org/10.1007/s13593-012-0105-x.)

5 AGROCHEMICALS & SUSTAINABLE AGRICULTURE

SDG-ALIGNMENT: THIS STANDARD CONTRIBUTES TO ACHIEVING THE FOLLOWING SDGS:

PILLARS 2 & 3

SUSTAINABLE OPERATIONS
SUSTAINABLE VALUE CHAINS

SDG 2 – Zero hunger

Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.

SDG 3 – Good health and well-being

Target 3.9: By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.

SDG 6 – Clean water and sanitation

Target 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

SDG 12 – Responsible consumption and production

Target 12.4: By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment.

Target 12.6: Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle.

SDG 14 – Life below water

Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.

SDG 15 – Life on land

Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.

Target 15.3: By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world.

STEPS TO MEET THE COMMITMENT

1. ADOPT A POLICY AND EMBED IT INTO GOVERNANCE AND MANAGEMENT SYSTEMS

1.1. ADOPT A POLICY

The board or the most senior level of SDG-aligned companies adopt a policy aligned with the human rights to food, health, water, a healthy environment, a decent standard of living, and life, and centered on a public commitment to (1) minimize the use of agrochemicals in company operations and value chains; and (2) support and adopt sustainable and regenerative agricultural practices in company operations and value chains that preserve natural resources and protect the health of ecosystems and people, including workers and communities in proximity to operations.

1.2. EMBED THE POLICY INTO GOVERNANCE & MANAGEMENT SYSTEMS

To embed the policy, SDG-aligned companies:

- Communicate expectations for implementing the policy internally and externally to the workforce, shareholders, subsidiaries' governing bodies, and business relationships, including through contractual terms with suppliers.
- Integrate the policy into the procurement policy, responsible sourcing policy, and contract terms with suppliers and other business relationships in the value chain.[18]
- Integrate the policy into by-laws, other governance documents (i.e., Code of Conduct, Code of Ethics), and management procedures.
- Ensure their business practices and the incentives they create do not contradict the policy commitment in form or substance.

2. ASSESS ACTUAL & POTENTIAL IMPACTS

SDG-aligned companies identify and assess agricultural practices, including the use of agrochemicals, in their operations and value chains and their real or potential impacts, including degradation of natural resources (e.g., soil, water), threats to biodiversity, damage to ecosystem health, or threats to public health. To accomplish this, SDG-aligned companies:

- **Evaluate their main plant and animal-based sources and how their production practices may contribute to agrochemical use and agricultural activities that are detrimental** to soil, water, or ecosystem health. In particular, they assess their or their suppliers' attempts to realize maximum profits and yields at the expense of environmental or human health through these practices (e.g., the common use of blanket antibiotics among livestock to compensate for poorly run farms or save on veterinary bills[19]).
- **Engage qualified and credible experts**, including agronomists, agricultural scientists, livestock animal scientists, public health professionals, and epidemiologists, as well as producers themselves, to conduct comprehensive assessments.
- **In partnership with affected stakeholders and subject-matter experts, conduct comprehensive assessments** of their activities at global, national, regional, and farm scales, including evaluation of their:
  - **Use of agrochemicals, and its real or potential impacts on ecosystem health**, including:
    - **Degradation of ecosystems and natural resources**, including (1) water quality (i.e., through runoff, sewage, groundwater contamination, etc.); (2) soil quality, fertility, structure, or nutrient balance; (3) air quality.
    - **Risks to pollinators**.[e]
    - **Other biodiversity risks**, including (1) destruction of habitat through environmental degradation discussed above; (2) endocrine, reproductive, and growth disruptions; or (3) poisoning.
  - **Use of agrochemicals and their real or potential impacts on human health**, including an analysis of data on:
    - **Groups affected by agrochemical exposure**,[20] including as operators, workers, producers, bystanders, or residents of local communities.

e. Full details on risk assessment methodology can be found in: "Guidance on the Risk Assessment of Plant Protection Products on Bees (Apis Mellifera, Bombus Spp. and Solitary Bees)," *EFSA Journal* 11, no. 7 (2013): 3295, https://doi.org/10.2903/j.efsa.2013.3295.

        - **The types of agrochemicals used, any reported health effects among exposed groups**, and associated health risks documented in public health or epidemiology literature.
        - **Exposure routes**, including aerosol inhalation, contaminated water, dermal, residue on foliage, multiple application accumulation, etc.
        - **Application precision**, meaning the degree to which agrochemicals reach their targets through the most precise method possible.
        - **The rate of agrochemical exposure of exposed groups** calculated using internationally accepted reference values and models.[21] Where reference values are not available due to scientific uncertainties or only a single application (i.e., bolus) of an agrochemical is used, an absolute quantity is used.
    - **Risk of antibiotic resistance:**[22]
        - **Quantities or antibiotics and other antimicrobials used.**
        - **Exposure routes**, including animal diets, animal waste/manure, animal-human contact.
        - **Proposed mechanisms for how antibiotic resistance is or may be** passed to human pathogens.
    - **Agricultural and production practices**, including:
        - **Intensive and unsustainable practices utilized**,[23] including (1) tilling, (2) irrigation; (3) monoculture cultivation; (4) overgrazing; (5) leaving fields barren after harvests.
        - **Real and potential impacts of their use**,[24] including (1) soil erosion or loss of quality (e.g., losses to structure, organic matter, and fertility or disruption in soil biota); (2) degradation of water quality due to runoff and other consequences.
- **After assessing current practices, SDG-aligned companies also conduct a forward-looking assessment** to determine:
    - **Yield or productivity impact scenarios:** an assessment of different trajectories to minimize agrochemical use and transform agricultural practices, including potential risks to productivity or yields if agricultural practices are transitioned too quickly or without adequate supports in place. Productivity risks are assessed and reported within the context of risks discussed above, balancing the need to maintain food security and livelihoods with human and environmental health concerns.[25]
    - **Opportunities to transition to sustainable practices:** an assessment of ways to mitigate impacts discussed above and activities across a company's operations and its value chain that are amenable to conversion to sustainable or regenerative practices.
    - **Potential transition plans:** an assessment of plans to move away from detrimental production practices, including heavy agrochemical use, towards sustainable and regenerative alternatives (*see Step 3.2.* for examples of such practices) that are suitable in the particular environment of each supplier's land or area. These plans are assessed in conjunction with suppliers and producers and include:
        - **Determinations of the quantity and type of agrochemicals that can be used** within safe environmental and human health limits while maintaining productivity during transitions away from agrochemical-heavy practices towards sustainable ones. These determinations are made in consultation with experts and align with the International Plant Nutrition's best management practices and *4 R framework* that specifies agrochemicals should be judiciously applied with careful consideration of the right product, *right rate, right time, and right place*.[26]
        - **Feasible but ambitious timelines** for agrochemical reduction and implementation of sustainable agricultural practices.

While SDG-aligned companies may use certification schemes (e.g., *USDA Organic, Farm Sustainability Assessment (FSA)*) to inform their assessment criteria, these certifications do not encompass all facets of the standard. The companies, therefore, do their own due diligence to ensure to conduct comprehensive assessments that address the standard in full.

f. While the definition of "regenerative" agriculture is not yet legally established, here, "regenerative" is used to distinguish production practices that have positive environmental impacts or enhance natural resources such as improving soil quality. (Source: Peter Newton et al., "What Is Regenerative Agriculture? A Review of Scholar and Practitioner Definitions Based on Processes and Outcomes," *Frontiers in Sustainable Food Systems* 4 (2020), https://doi.org/10.3389/fsufs.2020.577723.).

3. INTEGRATE BY SETTING TARGETS & TAKING ACTION

SDG-aligned companies integrate the findings of their assessments of agricultural practices and agrochemical use and their real or potential impacts into relevant internal functions and processes by **setting targets** and then **taking action** to align with the standard within set target dates.

3.1. SET TARGETS

SDG-aligned companies set specific, time-bound intermediate and long-term targets to minimize the use of agrochemicals and promote sustainable agricultural practices that are ambitious enough to contribute significantly to the achievement of SDGs 2, 3, 6, 12, 14, and 15, and Targets 2.4 and 12.4 in particular. The intermediate targets are relevant for the companies to monitor their continuous improvement in meeting the standard. Where possible, these targets are relative, rather than absolute, and percent-based metrics to account for the direct relationship between increased food production and potentially increased utilization of agrochemicals and unsustainable agricultural practices. Examples of targets include:

- By 2023, the company achieves a 20% reduction in average pesticide use per area of cropland in its value chain.
- By 2025, the company has fewer than five instances of inappropriate use of agrochemicals during each reporting period.
- By 2025, 100% sourcing is from producers who have eliminated antimicrobial use for purposes other than therapeutic treatment of sick animals.
- By 2025, 90% of farms in the company's value chain have achieved neutral or positive trends in soil organic matter (SOM).
- By 2030, 90% of sourcing comes from producers utilizing one or more sustainable production practices.

In addition, the companies engage with suppliers to support them in meeting the targets and aligning with the standard, including formal transition plans developed in conjunction with producers and graduated requirements to meet targets (i.e., gradual reduction in agrochemical use and transition to IPM or biological control).

3.2. TAKE ACTION

SDG-aligned companies take appropriate measures to meet targets set to minimize agrochemical use and adopt sustainable agricultural practice in its operations and value chain. They also support suppliers and producers in the value chain in transitioning towards sustainable production practices. Importantly, the companies immediately require suppliers to cease:

- **Use of highly hazardous pesticides (HHPs)**[g] that cause "severe or irreversible harm to health or the environment" and whose negative effects are unduly borne by those in developing countries where they are not yet banned or appropriately regulated.[27]
- **Use of agrochemicals for which personal protective equipment (PPE) is required but is inaccessible, cost-prohibitive, or otherwise not consistently available**, which is especially problematic for smallholders and producers in developing countries.[28]
- **Spraying of agrochemicals in ways that most significantly increase pesticide drift** and pose the greatest risks of severe adverse impacts on biodiversity, environment, and human health including:[29] indiscriminate aerial spraying; spraying during high wind, inversion, low humidity and high temperature conditions; spraying with inappropriate boom height,[h] pressure, or droplet-size nozzle settings.

SDG-aligned companies then use their leverage and resources to support suppliers and producers in their value chain in meeting the standard by providing:

- **Technical assistance, educational & training programs, and other extension services** to:
  - **Implement transition plans to minimize agrochemicals**, including training and aiding producers in steadily reducing quantities of agrochemicals used in their operations during transitions and step-down trajectories while maintaining yields and livelihoods, ensuring food security, and minimizing risks to the environment and human health.[30] It may also include implementing strategies for mitigating risks of agrochemicals during transitions such as buffer zones[31] and agrochemical additives that prevent leaching into the natural environment or their conversion to greenhouse gasses (i.e., nitrous oxide from nitrogen-based fertilizers).[32]

g. Eight criteria are used to determine if a pesticide is classified as "highly hazardous." Full details on all of the criteria can be found in: Inter-Organization Programme for the Sound Management of Chemicals, WHO, and FAO, *The International Code of Conduct on Pesticide Management*.

h. Boom height is the distance from the applicator nozzle to the target. (Source: Kruger et al., "Spray Drift of Pesticides.")

- **Adopt sustainable and regenerative agricultural practices** that render crops and soils more resistant to disease, improve soil quality and structure, provide biological, rather than synthetic, pest control and growth promotion options, and reduce external inputs. Examples of these practices that can both help in the transition to minimize agrochemical use and can be used long-term in resilient, sustainable food production include:
  - Agroecological practices including agroforestry, polyculture (i.e., intercropping or diversified cropping systems), cover cropping, crop rotation, soil fertility management, appropriate climate-crop selection, and synergistic planting.[33]
  - Sustainable Intensification.[i]
  - Precision agriculture[j] and targeted application of agrochemicals, including more frequent but lower dose, application of nitrogen-based fertilizers to ensure proper nutrient management and optimized uptake.[34]
  - Integrated Pest Management.[k]
  - Organic pesticide[l] use.
  - Biological controls, including microbial pesticides,[m] parasitic insects, and pheromones.[35]
- **Implement alternatives to antimicrobials**[36] in animal-based operations, including:
  - Good hygiene and vaccinations.
  - Adequate ventilation, clean water sources, and appropriate stock densities for the allocated spaces.
  - Transitioning to heritage and specific breeds that may have a naturally higher resistance to disease.
  - Feed additives (to replace the usage of antimicrobial agents to promote livestock growth).
- **Financing & incentives** to encourage and support producers in participating in the activities discussed above, including:
  - Fellowships, grants, and pilot programs that help producers secure training, equipment, or supplies.
  - Contractual incentives that specify higher prices/premiums be paid when targets to decrease agrochemical use or implement sustainable or regenerative practices are attained. Other incentives may include longer-term contracts for producers that have reached targets or that commit to doing so on a specified timeline and risk mitigation clauses that provide financial protection from income losses stemming from transition issues.
  - Direct payments to producers and other agricultural actors to pay for sustainable or regenerative practices (e.g., paying a producer to take a field out of production for a year, plant cover crops, and contract with a livestock producer to graze the land in an effort to restore soil health).

  These financial benefits and incentives are of particular importance. While some sustainable practices that reduce the costs of input and labor or increase productivity may yield higher revenue immediately, others require larger upfront investment or have longer-term payoffs. Without financial support, farmers, livestock ranchers, and other producers, especially smallholders, may not be able to absorb the risks and/or costs associated with transitioning away from agrochemical-heavy practices and implementing new, sustainable ones; understandably, if not economically feasible, producers will abandon these practices or simply not implement them at all.[37]

If, after reasonable time and provision of adequate resources and support, suppliers and other business relationships do not alter their practices and align with the company expectations or contractual terms to meet the standards, SDG-aligned companies disengage from the business relationship.

i. Sustainable intensification (SI) involves increasing or maintaining yields " to produce more food without environmental harm, or even with positive contributions to natural and social capital." SI may be realized through multiple practices that may include rotational grazing, crop rotation, polycultures/diversified cropping systems, soil conservation (e.g, reducing or eliminating tilling), and crop variety improvements. (Source: Jules Pretty and Zareen Pervez Bharucha, "Sustainable Intensification in Agricultural Systems," *Annals of Botany* 114, no. 8 (December 1, 2014): 1571–96, https://doi.org/10.1093/aob/mcu205.)

j. Precision agriculture harnesses technology to collect frequent data on specific sensors in agricultural systems, model and predict outcomes with changes in practices or inputs, apply treatments (e.g., fertilizers) with precise control, and track actual outcomes. This results in an overall decreased need for agrochemical use and potential for greater yields using fewer inputs. (Source: "Precision, Geospatial and Sensor Technologies Programs | National Institute of Food and Agriculture," accessed May 30, 2021, https://nifa.usda.gov/program/precision-geospatial-sensor-technologies-programs.)

k. Integrated Pest Management (IPM) involves "the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human and animal health and/or the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms." (Source: Inter-Organization Programme for the Sound Management of Chemicals, WHO, and FAO, *The International Code of Conduct on Pesticide Management*.)

l. Organic pesticides are typically made from natural substances such as lime, sulfur, hydrogen peroxide, and essential oils. While these may still have detrimental effects, they may be lesser, especially on pollinators and can be helpful as part of IPM programs and transitioning away from synthetic agrochemical use. (Source: "Organic Pesticides - Comparative Overview" (Xerces Society for Invertebrate Conservation, 2019).)

m. Microbial pesticides are bacteria or fungi that target specific pests. Parasitic insects are natural predators of target pests. Use of both biological control options aim to kill target pests without harm to pollinators and other ecosystem aspects. Pheromones are molecules that confuse target pests,, preventing them from reproducing or deterring them from certain areas. Importantly, these pest control strategies may have greater specificity for their target pests and, thus, preserve biodiversity. (Source: "Biological 'Green' Alternatives to Chemical Pesticides : USDA ARS.")

SDG-aligned companies also act upon its findings and use their leverage to support, promote, and/or constructively participate in:

- **Research & development** of:
  - Scalable agroecological, sustainable, and regenerative practices that improve soil and land quality, protect ecosystem health and reduce dependence on external inputs
  - Perennial crops and breed improvements such as those that: increase nitrogen use efficiency (NUE), including the development of grains that can fix nitrogen themselves, reducing the need for external fertilizer inputs;[38] include biological nitrification inhibition (BNI) that prevent losses of nitrogen from the soil;[39] improve soil structure and fertility through root structures and functions;[40] and improve livestock resistance to disease and growth rates.
  - "Enhanced efficiency fertilizers" and other agrochemicals with additives (e.g., coatings, polymer matrices, urease, and nitrification inhibitors) that prevent greenhouse gas formation and leaching into waterways as well as control the release of and more precisely deliver nutrients to target crops. These additives[n] may help during the transition to a reduced agrochemical world by reducing the overall quantity needed to maintain productivity and by mitigating environmental harms until an absolute minimum of agrochemical use can be feasibly realized.[41]
  - Innovative technologies (e.g., farm management software, precision agriculture apps, etc.) to improve and scale regenerative farming and livestock production practices and reduce the overall need for agrochemical inputs.
- **Existing multi-stakeholder initiatives** by governmental, environmental, agricultural, or academic institutions, industry peers, or non-profits to pilot, improve, or scale sustainable and regenerative agriculture practices and minimize agrochemical use. This may also include using leverage to support the standardization, expansion, or improvement of certification schemes.
- **Supporting, and not impeding, policy change initiatives** that promote industry-wide transparency and usage standards as well as drawdown requirements for agrochemicals in food production; funding for sustainable and regenerative agriculture research and education programs; elimination of subsidies for agrochemicals and implementation of taxes and more stringent regulations around their excessive or inappropriate[o] use,[42] which has been shown to better both environmental and human health outcomes.[43]

4. ESTABLISH AND PARTICIPATE IN EFFECTIVE GRIEVANCE MECHANISMS & PROVIDE OR ENABLE REMEDY

4.1. ESTABLISH GRIEVANCE MECHANISMS

SDG-aligned companies have and use leverage to ensure their business relationships have effective[p] grievance mechanisms in place that are accessible to stakeholders to report inappropriate use of agrochemicals and adverse impacts on human or environmental health.

Importantly, the companies ensure workers and their families, as well as other exposed groups, are proactively informed of known risks associated with pesticide exposure, toxicity symptoms and treatment options, systems in place to report adverse effects of exposure, and protections to report without retaliation (e.g., job loss, disciplinary action). This information is provided by the companies or their business relationships in an accessible and easily understandable format and presented in native languages.[44] The companies also ensure that in their own operations and across their value chains, there are procedures in place to contact emergency services and transport workers experiencing acute toxicity from agrochemical exposure to medical facilities.[45]

4.2. COOPERATE IN STATE-BASED GRIEVANCE MECHANISMS

SDG-aligned companies refrain from using legal waivers that preclude access to judicial recourse for victims of inappropriate use of agrochemicals. The companies cooperate with and support legitimate judicial and non-judicial State-based mechanisms to report and adjudicate violations.[46] Where State-based mechanisms order sanctions or remedy, the companies comply and use leverage to ensure their business relationships comply.

n. Agrochemical additives are substances agrochemicals can be combined or coated with before application that control their release, creating a more sustained, targeted effect. (Source: Searchinger et al., "World Resources. Creating a Sustainable Food Future. A Menu of Solutions to Feed Nearly 10 Billion People by 2050.")

o. Inappropriate use of agrochemicals is defined here as usage that violates national pesticide safety regulations and precautionary principles such as providing personal protective equipment (PPE), pesticide information, and training to all exposed workers and following strict safety protocols during active spraying/application. Examples of safety protocols can be found in: OCSPP US EPA, "Agricultural Worker Protection Standard (WPS)," Overviews and Factsheets, US EPA, September 18, 2014, https://www.epa.gov/pesticide-worker-safety/agricultural-worker-protection-standard-wps.

p. As defined by the UNGPs' Effectiveness Criteria for Non-Judicial Grievance Mechanisms ("In order to ensure their effectiveness, non-judicial grievance mechanisms, both State-based and non-State-based, should be: (a) Legitimate… (b) Accessible… (c) Predictable… (d) Equitable… (e) Transparent… (f) Rights-compatible… (g) A source of continuous learning… Operational-level mechanisms should also be: (h) Based on engagement and dialogue…" (see UNGP 31 for further information). (Source: United Nations, "Guiding Principles on Business and Human Rights: Implementing the United Nations 'Protect, Respect and Remedy' Framework," 2011, https://www.ohchr.org/Documents/Publications/GuidingPrinciplesBusinessHR_EN.pdf.)

4.3. PROVIDE OR ENABLE REMEDY

When a company identifies adverse impacts on human health or the environment from the use of agrochemicals in its own operations or value chain, it acknowledges its part in the harm done, and provides remedy through legitimate processes. Where the company did not cause or contribute to the harm directly, it enables remedy through legitimate processes. Remedy for these impacts may include:

- Providing monetary compensation for those whose health was harmed by the use of agrochemicals.
- Actively carrying out, supporting, and/or financing natural ecosystem restoration that support soil erosion reduction, water quality, and wildlife habitat recovery where agrochemical use has caused damage.

To ensure instances do not occur again, SDG-aligned companies alter their own and their value chain's agricultural practices, employee training, safety, procurement, and regulatory policies, and business relationships.

5. TRACK PERFORMANCE

SDG-aligned companies track the implementation of actions to meet the standard within their own target dates through qualitative and/or quantitative performance indicators on an ongoing basis and in partnership with actors in its value chain. In order to fulfill this step of meeting the standard, the companies may require information about agrochemical use and agricultural practices as well as requirements to regularly report on relevant performance indicators as part of their contractual terms with suppliers and other value chain actors.

Examples of performance indicators that indicate progress towards decreasing agrochemical use and ensuring agricultural sustainability include:

- Measures of agrochemical and nutrient use efficiency:
  - $$\text{Nitrogen}^{q}\ \text{Use Efficiency (NUE)}^{r} = \frac{KgNharvestedpercropperyear}{KgNinputpercropperyear}$$
  - Sustainable Nitrogen Management Index (SNMI)[s]
- Percent change in average pesticide use per area of cropland (i.e., $\frac{(\text{Kg totalpesticides (active ingredients)used peryear)}}{(\text{Ha croplandutilized))}}$
- Pesticide risk indicators: Aquatic Risk Indicators (ARI) and Terrestrial Risk Indicators (TERI)[t]
- Number of grievances raised about inappropriate use of agrochemicals or number of incidents of agrochemical harm to humans or the environment in company operations and value chains.
- Percentage of supplier fields or weight of total crops grown using sustainable practices (e.g.,

$$IPMpercentage = \frac{AreaoffieldsorkgofcropsgrownusingIPMpractice}{Totalareaoffieldorkgofcropsourcedbythecompany}$$

- Trends in *Soil Organic Matter (SOM)*, which is well-correlated with and functions as an indicator for both soil degradation and erodibility.[u]
- Dynamic[v] soil quality indicators (e.g., structure & presence of macropores, infiltration rate, available water capacity, etc.).[47]
- Percentage of sourcing from suppliers who have eliminated antimicrobial use for purposes other than therapeutic treatment of sick animals (i.e., for growth promotion or blanket prevention)
- Average dose or mass-based measure of antimicrobial use
  - e.g., ***Number of Defined Daily Doses (DDD) per 100 animal days***, which provides an estimate of the percentage of animals treated daily on a farm:[48]

$$\sum_{i=1}^{n} \frac{(\text{amount (mg) of antimicrobials used in time period})}{(DDD_i\ (\text{mg/kg/day}) \times \#\ \text{animal days in period} \times \text{average weight for life stage (kg)})} \times 100$$

Average weight for life stage is used in this calculation to account for the fact that there are seasonal and production stage variations in animal weight (e.g., suckler, weaner, and fattener pigs) and antimicrobial use can be heavier towards the beginning of the life stage.[49]

q. Adding more and more nitrogen will eventually result in diminishing returns in terms of yields and increased environmental pollution. (Source: Xin Zhang and Eric Davidson, "Sustainable Nitrogen Management Index (SNMI): Methodology," 2019, 4.)

r. According to experts, "improving nitrogen-use efficiency (NUE) is one of the most effective means of increasing crop productivity while decreasing environmental degradation." (Source: Zhang et al., "Managing Nitrogen for Sustainable Development.")

s. Sustainable Nitrogen Management Index (SNMI) is a geometric value plotted spatially that standardizes Nitrogen Use Efficiency by yield and accounts for NUE values greater than one; above one, NUE is actually detrimental as nitrogen is being "mined" from the soil during crop harvesting. (Source: Zhang and Davidson, "Sustainable Nitrogen Management Index (SNMI): Methodology.")

t. Full details on the calculations for these risk indicators can be found in: "Pesticides: Risk Indicators - OECD," accessed June 17, 2021, https://www.oecd.org/env/ehs/pesticides-biocides/pesticides-risk-indicators.htm.

u. Soils with higher SOM tend to have better structure and aggregate stability, rendering them more resilient against erosion. (Source: S. Obalum, G. Chibuike, and S. Peth, "Soil Organic Matter as Sole Indicator of Soil Degradation," *Environmental Monitoring and Assessment* Volume 189, no. 4 (2017), https://doi.org/10.1007/s10661-017-5881-y.)

v. Soil quality is determined by both inherent and dynamic characteristics; the former are relatively stable and unchanging based on geographic location and climate while the latter can change on timescales or seasons or years and are amenable to change based on agricultural inputs and practices. (Source: USDA NRCS, "Soil Quality Physical Indicators: Selecting Dynamic Soil Properties to Assess Soil Function," September 2008, https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_050948.pdf.)

6. DISCLOSE PERFORMANCE

To enable transparency and accountability, SDG-aligned companies communicate publicly on their performance against their agrochemicals and sustainable agriculture commitment and targets, particularly when concerns are raised by or on behalf of affected stakeholders. Where relevant, SDG-aligned companies also share aggregate data and high-level findings directly with affected stakeholders and organizations, including human rights organizations and researchers.

Regular public disclosure is accurate, clear, accessible, and third-party verified information about the actual and potential impacts related to their agrochemical use and agricultural practices in their operations and value chain, their efforts to address these to implement their policy commitment, and performance against targets. Disclosure includes sufficient information to evaluate the adequacy of the company's approach and activities. Formal disclosure includes information on the following:

- **The results of their formal assessments** of production practices and opportunities in their operations and supply chains including quantities and types of agrochemicals used, real or potential impacts of agrochemical use on environmental or human health, and opportunities for sustainable practices, including advised opportunities that were not, or have not yet been, adopted.
- **Methods used to assess their operations and value chain**, including experts consulted, affected stakeholders engaged, assumptions made, and data sources (e.g., supplier reported).
- **Measures taken during the reporting period to prevent, mitigate, or address the negative impacts of agrochemicals**, including measures taken to transition minimize their use (e.g., requiring and monitoring supplier implementation of buffer zones).
- **Measures taken during the reporting period to adopt sustainable or regenerative production practices** in company operations and value chains.
- **Any immediate or graduated contractual changes and the supports offered to suppliers**, including training or technical assistance protocols and funding.
- **Progress on relevant performance indicators**, even when progress is not as good as expected, and a company falls short of targets set. When a company fails to meet its own targets, it discloses key learnings and delineates how it is modifying its strategy and efforts to still achieve intermediate and long-term targets to minimize agrochemical use and implement sustainable practices in its own operations and value chain.
- **Any measures to support research and development, policy changes, educational programs, or scaling of technologies** that reduce agrochemical use and promote sustainable food production practices, undertaken independently or in partnership with industry peers, organizations, or government bodies.
- **Any specific impacts or grievances** in which inappropriate agrochemical use caused harm to ecosystems or human health in company operations or value chains. In disclosing these instances, the companies specify the agrochemical misused, when the instance occurred, the location, the number of people exposed (if applicable), any medical outcomes that resulted, the extent of environmental damage (if applicable),[50] and any remedy provided.

ENDNOTES

1. UNEP, "Global Chemicals Outlook II: From Legacies to Innovative Solutions," 2019, https://www.unep.org/resources/report/global-chemicals-outlook-ii-legacies-innovative-solutions?_ga=2.120524488.1320598646.1628196546-1830782973.1626804635.
2. George Tyler Miller, *Sustaining the Earth: An Integrated Approach*, 6th ed., 2004, http://archive.org/details/sustainingearthi0000mill; Sergey M. Govorushko, *Natural Processes and Human Impacts: Interactions between Humanity and the Environment* (Springer Netherlands, 2012), https://doi.org/10.1007/978-94-007-1424-3.
3. FAO, "Animal Production," Antimicrobial Resistance, 2021, http://www.fao.org/antimicrobial-resistance/key-sectors/animal-production/en/.
4. Xin Zhang et al., "Managing Nitrogen for Sustainable Development," *Nature* 528, no. 7580 (December 2015): 51–59, https://doi.org/10.1038/nature15743; W. Steffen et al., "Planetary Boundaries: Guiding Human Development on a Changing Planet," *Science* 347, no. 6223 (February 13, 2015): 1259855–1259855, https://doi.org/10.1126/science.1259855; US Department of Commerce, "What Is Eutrophication? | National Ocean Service - National Oceanic and Atmospheric Administration," accessed June 1, 2021, https://oceanservice.noaa.gov/facts/eutrophication.html; Jafar Massah and Behzad Azadegan, "Effect of Chemical Fertilizers on Soil Compaction and Degradation," *Ama, Agricultural Mechanization in Asia, Africa & Latin America* 47 (December 1, 2016): 44–50; "Managing the Biodiversity Impacts of Fertiliser and Pesticide Use: Overview and Insights from Trends and Policies across Selected OECD Countries," OECD Environment Working Papers, vol. 155, OECD Environment Working Papers, March 13, 2020, https://doi.org/10.1787/63942249-en.
5. WHO, "Pesticides and Health," 2004, https://www.who.int/mental_health/prevention/suicide/en/PesticidesHealth2.pdf.
6. Wolfgang Boedeker et al., "The Global Distribution of Acute Unintentional Pesticide Poisoning: Estimations Based on a Systematic Review," *BMC Public Health* 20, no. 1 (December 7, 2020): 1875, https://doi.org/10.1186/s12889-020-09939-0.
7. European Parliament. Directorate General for External Policies of the Union., *The Use of Pesticides in Developing Countries and Their Impact on Health and the Right to Food*. (LU: Publications Office, 2021), https://data.europa.eu/doi/10.2861/28995.
8. Julia Baudry, Karen E. Assmann, and Mathilde Touvier, "Association of Frequency of Organic Food Consumption With Cancer Risk: Findings From the NutriNet-Santé Prospective Cohort Study," *JAMA Internal Medicine* 178, no. 12 (2018): 1597–1606.
9. Henrik C. Wegener et al., "Use of Antimicrobial Growth Promoters in Food Animals and Enterococcus Faecium Resistance to Therapeutic Antimicrobial Drugs in Europe - Volume 5, Number 3—June 1999 - Emerging Infectious Diseases Journal - CDC," accessed May 31, 2021, https://doi.org/10.3201/eid0503.990303; FAO, "Animal Production"; WHO, "Antimicrobial Resistance," WHO (World Health Organization, 2021), http://www.who.int/antimicrobial-resistance/global-action-plan/optimise-use/antimicrobials/en/.
10. FAO, "Animal Production"; OCSPP US EPA, "Slowing and Combating Pest Resistance to Pesticides," Overviews and Factsheets, US EPA, May 12, 2016, https://www.epa.gov/pesticide-registration/slowing-and-combating-pest-resistance-pesticides.
11. FAO - The Intergovernmental Technical Panel on Soils, "Towards a Definition of Soil Health," 2020, https://www.fao.org/3/cb1110en/cb1110en.pdf.
12. FAO.
13. FAO.
14. Syed Arif Hussain Rizvi et al., "Latest Developments in Insect Sex Pheromone Research and Its Application in Agricultural Pest Management," *Insects* 12, no. 6 (May 23, 2021): 484, https://doi.org/10.3390/insects12060484.
15. UN Human Rights Council, "Report of the Special Rapporteur on the Right to Food" (United Nations, January 24, 2017).
16. Zhanping Hu, "What Socio-Economic and Political Factors Lead to Global Pesticide Dependence? A Critical Review from a Social Science Perspective," *International Journal of Environmental Research and Public Health* 17, no. 21 (January 2020), https://doi.org/10.3390/ijerph17218119.
17. "PRB's 2020 World Population Data Sheet," Population Reference Bureau, accessed June 17, 2021, https://interactives.prb.org/2020-wpds/.
18. Know The Chain, "Benchmark Methodology – Food & Beverage Sector," 2019, https://knowthechain.org/wp-content/uploads/KTC_Benchmark_Methodology_FB_2020_21.pdf.
19. Charlotte Doidge et al., "Farmers' Perceptions of Preventing Antibiotic Resistance on Sheep and Beef Farms: Risk, Responsibility, and Action," *Frontiers in Veterinary Science* 13 (August 13, 2020), https://www.frontiersin.org/articles/10.3389/fvets.2020.00524/full.
20. "Guidance on the Assessment of Exposure of Operators, Workers, Residents and Bystanders in Risk Assessment for Plant Protection Products," *EFSA Journal* 12, no. 10 (2014): 3874, https://doi.org/10.2903/j.efsa.2014.3874.
21. Reference values (i.e., assumptions of body weights, breathing rates, absorption values, etc.) can be found in: "Guidance on the Assessment of Exposure of Operators, Workers, Residents and Bystanders in Risk Assessment for Plant Protection Products."
22. Ya He et al., "Antibiotic Resistance Genes from Livestock Waste: Occurrence, Dissemination, and Treatment," *Npj Clean Water* 3, no. 1 (February 19, 2020): 1–11, https://doi.org/10.1038/s41545-020-0051-0.
23. Elizabeth Temitope Alori, Aruna Olasekan Adekiya, and Kehinde Abodunde Adegbite, "Impact of Agricultural Practices on Soil Health," in *Soil Health*, ed. Giri B., Varma A., vol. 59, Soil Biology (Springer, 2020), https://doi.org/10.1007/978-3-030-44364-1_5; FAO, "NSP - Agriculture and Soil Biodiversity," Plant Production and Protection Division, accessed November 18, 2021, https://www.fao.org/agriculture/crops/thematic-sitemap/theme/spi/soil-biodiversity/agriculture-and-soil-biodiversity/en/.
24. FAO, "NSP - Agriculture and Soil Biodiversity."
25. Popp, Pető, and Nagy, "Pesticide Productivity and Food Security. A Review."
26. T.L. Roberts, *Fertilizer Best Management Practices: General Principles, Strategy for Their Adoption and Voluntary Initiatives vs Regulations*, 1st ed. (Paris, France: International fertilizer industry Association, 2007); A. M. Johnston and T. W. Bruulsema, "4R Nutrient Stewardship for Improved Nutrient Use Efficiency," Procedia Engineering, SYMPHOS 2013 - 2nd International Symposium on Innovation and Technology in the Phosphate Industry, 83 (January 1, 2014): 365–70, https://doi.org/10.1016/j.proeng.2014.09.029; CS Snyder et al., "Agriculture: Sustainable Crop and Animal Production to Help Mitigate Nitrous Oxide Emissions," *Current Opinion in Environmental Sustainability*, SI: System dynamics and sustainability, 9–10 (November 1, 2014): 46–54, https://doi.org/10.1016/j.cosust.2014.07.005.
27. Boedeker et al., "The Global Distribution of Acute Unintentional Pesticide Poisoning."
28. Inter-Organization Programme for the Sound Management of Chemicals, WHO, and FAO, *The International Code of Conduct on Pesticide Management*.
29. Greg R. Kruger et al., "Spray Drift of Pesticides" (University of Nebraska - Lincoln, n.d.).
30. Zhang et al., "Managing Nitrogen for Sustainable Development."
31. UN Human Rights Council, "Report of the Special Rapporteur on the Right to Food."
32. Tim Searchinger et al., "World Resources. Creating a Sustainable Food Future. A Menu of Solutions to Feed Nearly 10 Billion People by 2050.," World Resources Institute, Princeton University, 2018, https://wrr-food.wri.org/sites/default/files/2019-07/WRR_Food_Full_Report_0.pdf.
33. FAO (2018), "The 10 Elements of Agroecology: Guiding the Transition to Sustainable Food and Agricultural Systems," accessed June 15, 2021, http://www.fao.org/3/i9037en/i9037en.pdf; UN Human Rights Council, "Report of the Special Rapporteur on the Right to Food."
34. Searchinger et al., "World Resources. Creating a Sustainable Food Future. A Menu of Solutions to Feed Nearly 10 Billion People by 2050."
35. Rizvi et al., "Latest Developments in Insect Sex Pheromone Research and Its Application in Agricultural Pest Management."
36. FAO, "Animal Production."
37. Hu, "What Socio-Economic and Political Factors Lead to Global Pesticide Dependence?"
38. Searchinger et al., "World Resources. Creating a Sustainable Food Future. A Menu of Solutions to Feed Nearly 10 Billion People by 2050."

39. Searchinger et al., "World Resources. Creating a Sustainable Food Future. A Menu of Solutions to Feed Nearly 10 Billion People by 2050."

40. Athole H. Marshall et al., "A New Emphasis on Root Traits for Perennial Grass and Legume Varieties with Environmental and Ecological Benefits," Food and Energy Security 5, no. 1 (2016): 26–39, https://doi.org/10.1002/fes3.78.

41. Ahmed Akelah, "Polymers in the Controlled Release of Agrochemicals," in *Functionalized Polymeric Materials in Agriculture and the Food Industry*, ed. Ahmed Akelah (Boston, MA: Springer US, 2013), 133–92, https://doi.org/10.1007/978-1-4614-7061-8_3.

42. FAO (2018), "The 10 Elements of Agroecology: Guiding the Transition to Sustainable Food and Agricultural Systems."

43. UN, "Study on the Effects of Taxes and Subsidies on Pesticides and Fertilizers," 2020, https://wedocs.unep.org/bitstream/handle/20.500.11822/33582/STSPF.pdf?sequence=1&isAllowed=y.

44. "Exposed and Ignored: How Pesticides Are Endangering Our Nation's Farmworkers" (Farmworker Justice, 2013), https://kresge.org/sites/default/files/Exposed-and-ignored-Farmworker-Justice-KF.pdf.

45. EPA, *Pesticide Poisoning Handbook*, accessed June 1, 2021, https://www.epa.gov/sites/production/files/documents/rmpp_6thed_ch2_makingdiagnosis.pdf.

46. OECD, "OECD Due Diligence Guidance for Responsible Supply Chains in the Garment and Footwear Sector" (OECD Publishing, Paris, 2018), https://www.oecd-ilibrary.org/deliver?redirecturl=http%3A%2F%2Fwww.keepeek.com%2FDigital-Asset-Management%2Foecd%2Fgovernance%2Foecd-due-diligence-guidance-for-responsible-supply-chains-in-the-garment-and-footwear-sector_9789264290587-en&isPreview=true&itemId=%2Fcontent%2Fpublication%2F9789264290587-en.

47. USDA NRCS, "Soil Quality Physical Indicators: Selecting Dynamic Soil Properties to Assess Soil Function"; USDA NRCS, "Soil Quality Indicators - Total Organic Carbon," October 2009, https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_019177.pdf.

48. Pim Sanders et al., "Monitoring of Farm-Level Antimicrobial Use to Guide Stewardship: Overview of Existing Systems and Analysis of Key Components and Processes," *Frontiers in Veterinary Science* 7 (2020), https://doi.org/10.3389/fvets.2020.00540.

49. AACTING, "Guidelines for Collection, Analysis and Reporting of Farm-Level Antimicrobial Use, In the Scope of Antimicrobial Stewardship," 2019, https://aacting.org/swfiles/files/AACTING_Guidelines_V1.2_2019.07.02_54.pdf.

50. US EPA, "How to Report a Pesticide Incident Involving Exposures to People."