Business guidance *for deeper regeneration*

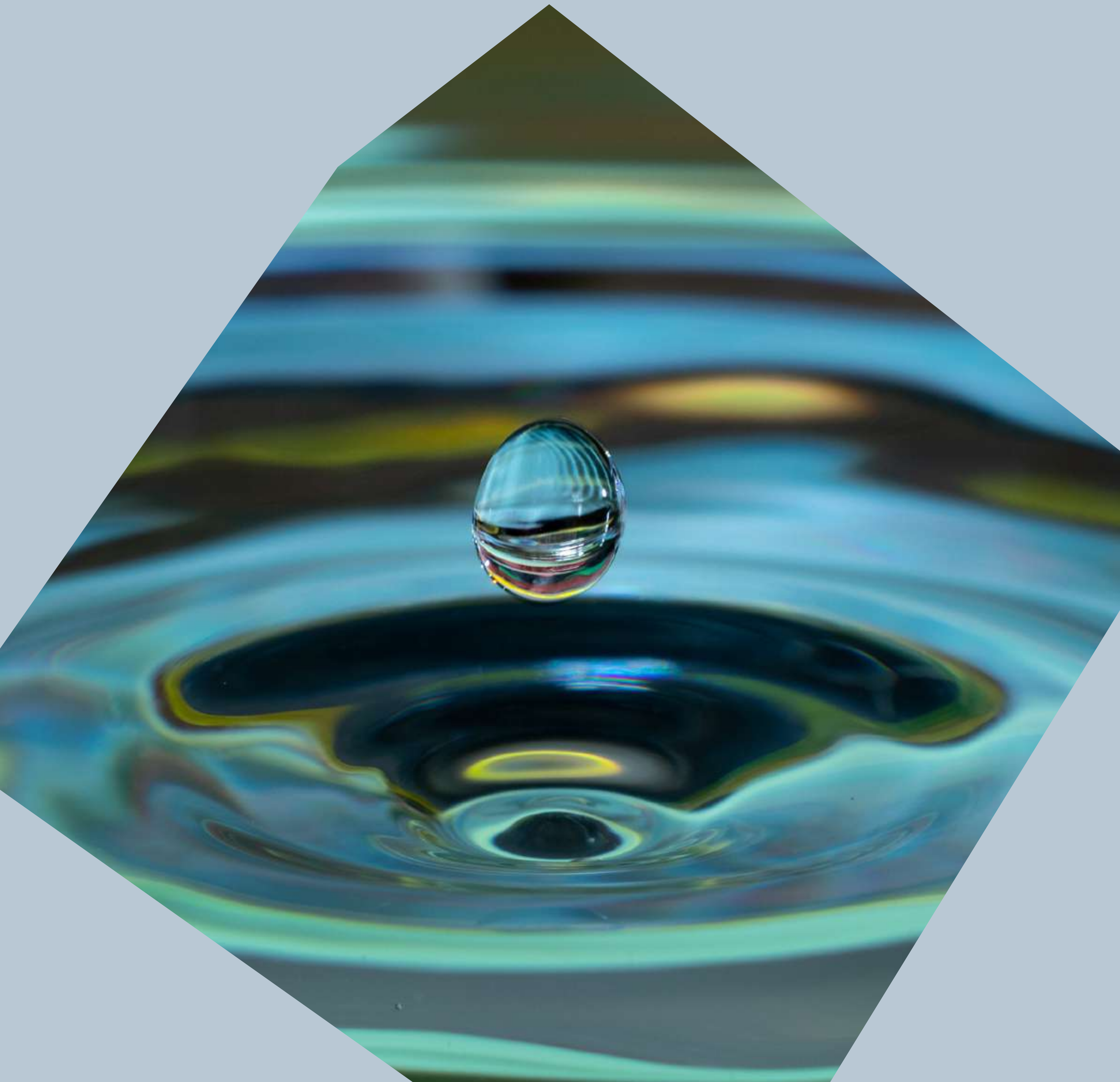
→ *Regenerative Agriculture Metrics: Water chapter*

World Business Council *for Sustainable Development*

op2b one planet business for biodiversity

Contents

Introduction



01.

01. Introduction

The imperative to transition to resilient and regenerative agricultural models

Amid the escalating climate crisis and compounding agricultural challenges, a shift in agricultural systems is becoming increasingly imperative. Farmers and agriculture value chain players are feeling the detrimental effects of these challenges while the economic system continues to rely on unsustainable practices. Regenerative agriculture emerges as a powerful counterpoint to business as usual – one that is adaptive, mitigative and resilient.

The opportunities from regenerative agriculture

Regenerative agriculture has gained momentum as a holistic solution to address climate challenges, reverse biodiversity loss and enhance soil health. Forward-thinking farmers have been pioneers in adopting regenerative practices on their lands. However, to scale up regenerative agriculture into a solution that drives significant environmental impact and helps society live within planetary boundaries, it is urgent to agree on how to measure and reward regenerative agriculture outcomes at farm, landscape and global scales.

The strong momentum to transition to resilient and regenerative agricultural models

The private sector is increasingly embracing regenerative agriculture for several reasons. First, the resilience of value chains depends on it. The agricultural industry is highly dependent on nature for ecosystem services, making it particularly vulnerable to climate change, biodiversity loss and water scarcity. Second, companies and financial institutions are shifting from voluntary to mandatory sustainability reporting and disclosure, which includes ambitious net-zero emissions and nature-positive strategies. Third, financial investments in regenerative agriculture are on the rise, supporting and de-risking the transition of farmers to these practices.[1] Furthermore, favorable policy environments in regions like North America and the European Union are creating incentives for the adoption of regenerative agriculture, encouraging businesses to champion this cause.

OP2B's working definition of regenerative agriculture

Related to agroecological evidence and principles, regenerative agriculture is a holistic, outcome-based farming approach that generates agricultural products while measurably having net-positive impacts on soil health, biodiversity, climate, water resources and farming livelihoods at the farm and landscape levels. It aims to simultaneously promote above- and below-ground carbon sequestration, reduce greenhouse gas (GHG) emissions, protect and enhance biodiversity in and around farms, improve water retention in soil, reduce pesticide risk, improve nutrient-use efficiency and improve farming livelihoods.

Convergence on measurement: The imperative to scale up

To accelerate the transition to regenerative agriculture and agricultural models that operate within planetary boundaries, it is essential to converge on an integrated measurement architecture. Business must address and overcome the key challenges to alignment: fragmented and siloed data collection and reporting, a lack of alignment on definition and outcomes, a need to translate global frameworks into local action plans and a lack of inclusivity of farmers and Indigenous peoples and local communities (IPLCs) in the process.

As regenerative agriculture gains momentum, the need to establish an aligned method for measuring environmental, social and economic outcomes grows. This will support greater transparency of claims made by businesses to counter greenwashing and unlock investments to finance the transition, as the world is already starting to hold business accountable for the progress it is making. The demands for increased accountability and transparency will only continue to rise.

The World Business Council for Sustainable Development (WBCSD) has prioritized strengthening the climate-, nature- and equity-related Corporate Performance and Accountability System by launching the joint Regenerative Agriculture Metrics working group (RAM) with the One Planet Business for Biodiversity (OP2B) coalition.[2,3] This collaborative effort involves more than 52 members and 32 business-focused partners, engaging more than 1,100 businesses.

The working group's goal is to align farm-, landscape- and global-level metrics with corporate reporting and to influence accounting, reporting and disclosure bodies to develop specific guidance for regenerative agriculture. Working group members and partners have initiated progress on this goal by aligning on metrics to measure climate-related outcomes in December 2023, water- and biodiversity-related outcomes in early 2024, and outcomes related to soils and socio-economics by mid-year.

Fostering alignment beyond the private sector requires a collective effort. WBCSD is a partner of Regen10, a multi-stakeholder initiative that brings together representatives from across food systems – from farmers and landscape stewards to companies – to explore the potential of regenerative approaches. Regen10 is currently developing a farmer-centric outcome-based framework to complement existing approaches and frameworks for regenerative food systems. The framework will support food system actors, including farmers and landscape stewards, through a holistic approach to incorporate socio-cultural, environmental and economic outcomes and outcome-based metrics into how they measure and track change in their farms and landscapes. Following an analysis of more than 150 existing frameworks, Regen10 published the Zero-Draft of the Outcomes Framework at the 28th United Nations Climate Change Conference (COP28).[4]

Regen10 is rigorously testing the Outcomes Framework with key stakeholder groups through extensive dialogues, consultations and on-the-ground trials throughout 2024. The final framework, when applied, will enable farmers and landscape stewards to collect primary data and evidence, receive rewards for positive outcomes and mobilize finance, thus accelerating a transition to deep regeneration. Through the Regenerative Agriculture Metrics working group and connecting with the Regen10 Outcomes Framework, WBCSD aims to identify and align on an integrated measurement architecture, connecting global ESG-level outcomes and metrics with those at the landscape and farm levels, the first step in creating an enabling environment to transition.

Achieving an *outcome-based approach*

02.

02. Achieving an *outcome-based approach*

Regenerative Agriculture Metrics working group members and partners support an outcome-based approach to regenerative agriculture that, at the broadest level, recognizes the need to incorporate and measure against environmental, social and economic categories. These three systems interlock to form a holistic outcome-based approach to regenerative agriculture that can bridge the gap between stakeholders and empower farmers by being cost-effective, context-specific, transparent and measurable.[5,6]

Figure 1 outlines the concept we used to organize and understand how metrics contribute to achieving regenerative agriculture outcomes that more broadly connect to the respective environmental, social and economic categories.

Figure 2 outlines a working set of outcomes for regenerative agriculture that encompasses the economic and social aspects that are critical to the success of regenerative systems, alongside environmental elements in line with the planetary boundaries associated with agriculture. While there is a general consensus on the environmental outcomes, the socioeconomic outcomes still require development through a multi-stakeholder approach. This report focuses on water-related outcomes: improved environmental flows and reduced water pollution (see Figure 2). We will refine the remaining working set of outcomes as the work progresses in 2024.

It is essential for industry to align at a metric level to measure these outcomes to ensure a homogenous value chain approach to regenerative agriculture. Alignment on metrics will drive consistency and comparability and underpin the challenges related to financing the transition to regenerative agriculture.

Figure 1: Taxonomy for outcome-based regenerative agriculture and how they relate to the three categories for a holistic approach to regenerative agriculture

Source: Adapted from Soloviev, E. & HowGood, Inc. (2023). Framework.

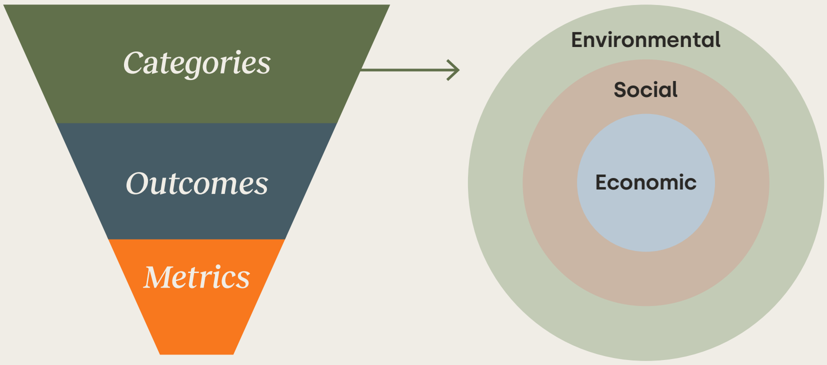
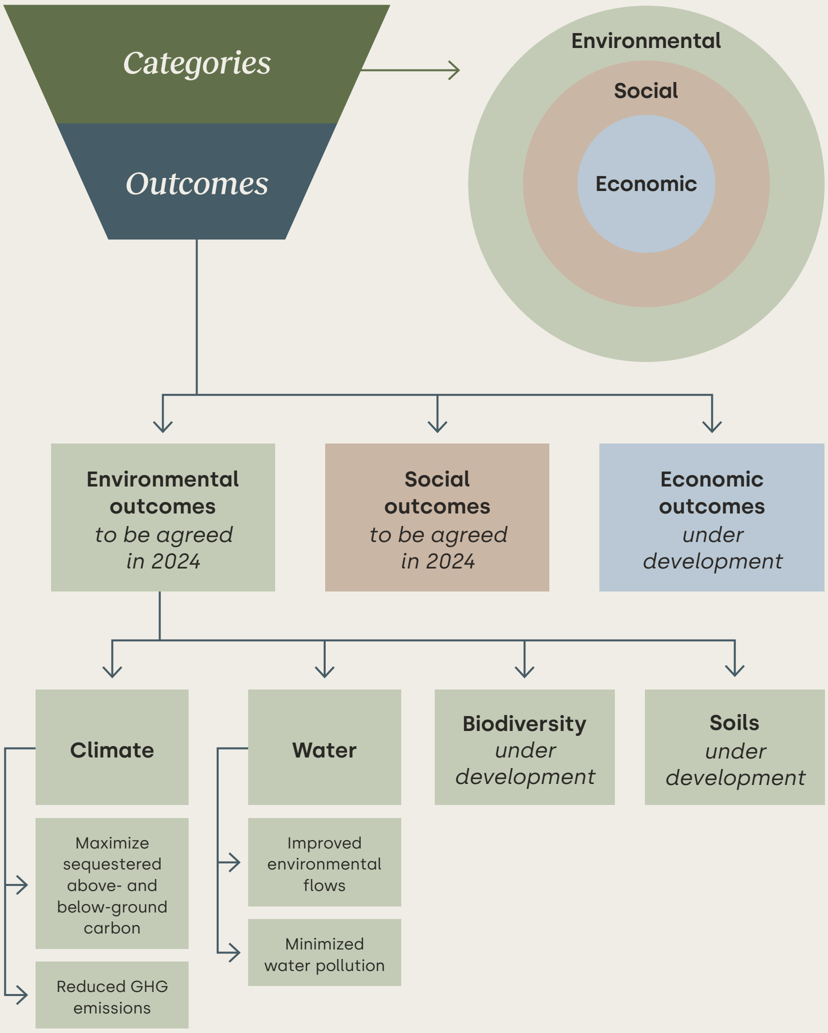


Figure 2: Working outcomes for regenerative agriculture at the corporate level showcasing agreed outcomes

Source: Includes figure adapted from Soloviev, E. & HowGood, Inc. (2023). Framework.



Measuring and reporting progress on Regenerative Agriculture at a company level

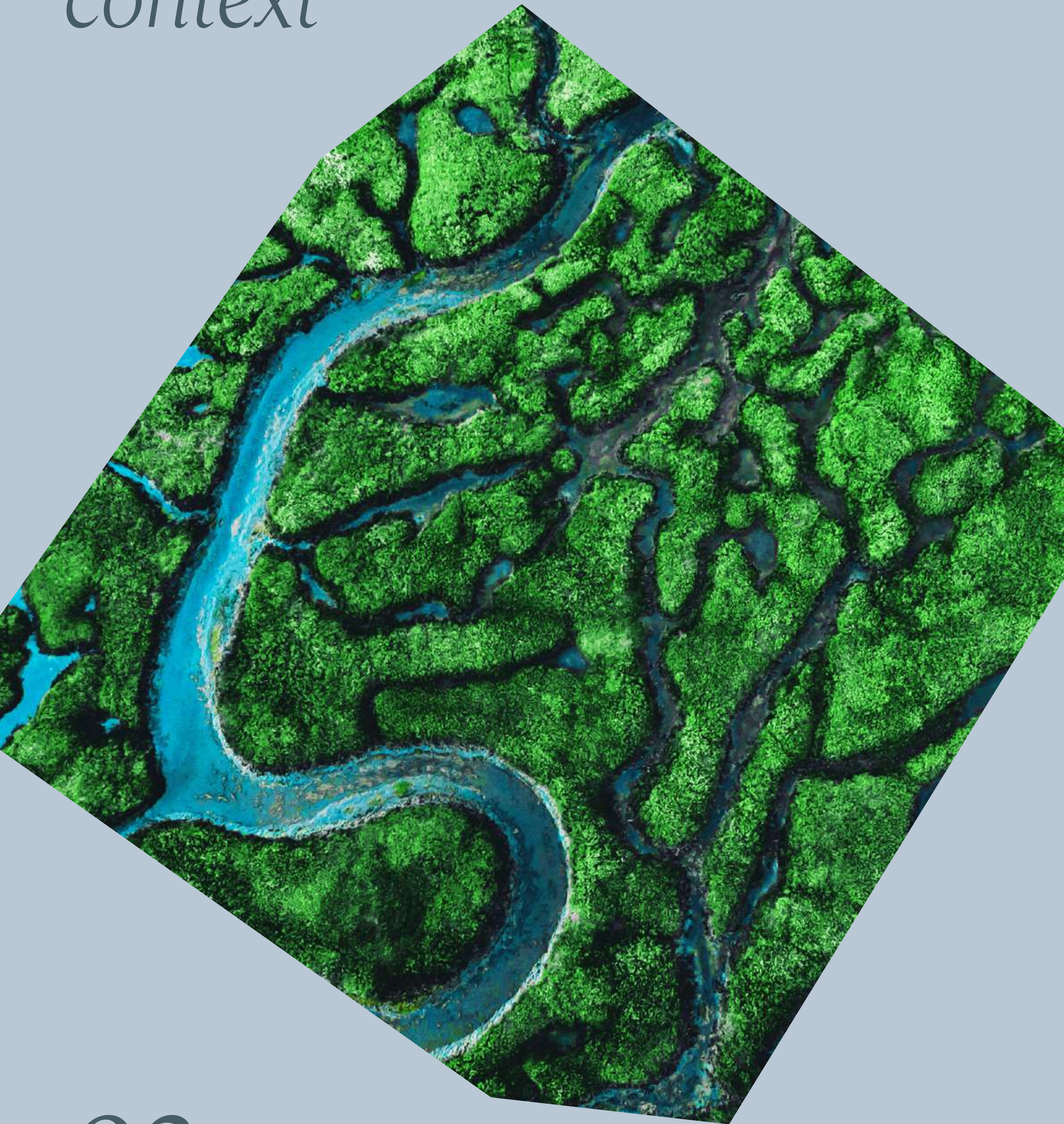
One of the major challenges for companies is to demonstrate their progress on regenerative agriculture credibly and transparently. To do so, companies typically measure progress either in terms of surfaces transitioned to regenerative agriculture (e.g., 30% of the sourcing regions converted to regenerative agriculture by 2030) or in terms of the share of ingredients sourced from regenerative agriculture (e.g., 30% of ingredients sourced through regenerative agriculture by 2030).

However, both approaches have challenges. On the one hand, measuring based on surfaces may cause a company to neglect a commodity with a significant impact that only occupies a small surface. On the other hand, when measuring based on ingredients, a company should define the correct unit (e.g., number of ingredients, share of volume, share of value) but may neglect an ingredient with high impact but represents a small share.

For companies that engage with the Science Based Targets Network (SBTN), measuring their impact is obtained by considering the quantity and origin of raw materials, the pressures on nature of each of these materials and the vulnerability of nature in the sourcing locations. These considerations require detailed information about the company's value chains and their nature-related materiality. However, in some cases involving a small number of key commodities with similar volumes and origins, companies may use measuring surfaces as a proxy to measure the impact.

It is critical to measure the outcomes of regenerative agriculture using a holistic approach that considers environmental, social and economic outcomes to ensure a complete picture of the impacts.

Nature & water *context*



03.

03. Nature & water context

3.1 The reliance of agricultural production on nature

According to the SBTN, nature refers to "all non-human living entities and their interaction with other living or non-living physical entities and processes," recognizing that "interactions bind humans to nature, and its subcomponents (e.g., species, soils, rivers, nutrients), to one another."[7] Nature has risen up the business agenda in recent years. There is no escaping rising nature-related risks – driving policymakers, regulators, investors, businesses, consumers and citizens to collectively call for rapid change. The 15th United Nations Biodiversity Conference (CBD COP15) culminated with the adoption of the Kunming-Montreal Global Biodiversity Framework (GBF) – setting a global ambition to halt and reverse nature loss by 2030, broadly understood as the "nature positive" pathway.[8] The goals and targets of the GBF align with the leading research on planetary boundaries[9] and the main drivers of nature loss: land-use change, climate change, pollution, natural resource use and exploitation, pollution and invasive species.[10]

The global agri-food system is crucial to feeding the world's growing population and to supporting the livelihoods of some 2.5 billion people. This system relies on healthy ecosystems – freshwater supply and quality, land and soil quality, pollination, disease and pest control, climate regulation and other critical ecosystem services. Yet in its current form, the system poses a significant threat to nature: food production is the largest driver of deforestation, water use, biodiversity loss and soil degradation globally.[11] This unsustainable baseline also means great opportunity – for nature recovery, farmer livelihoods and business growth. Indeed agriculture is both nature's biggest threat and humanity's best chance to halt and reverse nature loss.[12]

3.2 The impacts of agriculture on water resources

Agriculture accounts for around 70% of water withdrawals globally, with a wide range of regional variation (from around 20% in Europe to 50% in the Americas, and over 80% in Asia and Africa).[13] Agriculture is also one of the leading sources of water pollution globally, due to the often-unregulated or unenforced nonpoint discharge of contaminants including nutrients, pesticides, organic matter and plastic debris.[14] Additionally, irrigation and livestock watering severely impacts water withdrawal, especially in low-yielding farming systems.[15,16] These practices can severely affect water quality and are responsible for the bulk of surface-water eutrophication globally.[17]

Different agriculture activities can generate these impacts. Land clearance, for cultivation or grazing purposes, can impact water supply and flow regulation, so it is an important factor to consider when developing water management measures.[18,19] Pesticide use and wastewater discharge can both impact water quality as well as water supply.[20,21] Water withdrawal for irrigation or livestock watering can have major impacts on aquatic or ground-water dependent ecosystems through reducing water flows or levels.[22,23]

At a global scale, agriculture is a significant contributor to potential transgression of four of the nine environmental planetary boundaries.[24,25] Among these, biogeochemical flows of nitrogen and phosphorus and biosphere integrity are reaching particularly dangerous levels. Nitrogen and phosphorus pollution from agricultural fertilizers and livestock production contribute to disrupting the Earth's natural biogeochemical flows.[26] Similarly, the deterioration of water quality connected to agricultural practices like irrigation, wastewater discharge and pesticide application contributes to the loss of aquatic biodiversity, thus impacting biosphere integrity.[27]

Environmental flows and water quality

Abstraction of water from surface and groundwater for agricultural production is a major component of total water abstraction in many countries. Most water use for agriculture is for crop irrigation. Changes in environmental flows – defined as the quantity, timing and quality of water needed for functioning ecosystems – can be a high risk to the integrity of aquatic ecosystems and lead to large impacts on associated ecosystem services, particularly downstream and in areas of water stress. Many reporting frameworks ask companies to disclose how much water they withdraw from surface and groundwater, consume and discharge, often split by indicators of water stress and water source.

Alongside agricultural impacts on water quantity, poor management of agricultural inputs and wastewater have led to widespread impacts on water quality.[28] Agriculture can lead to impacts on multiple aspects of water quality. The intensification and expansion of agricultural systems are key sources of nutrient (nitrogen and phosphorous) and pesticide pollution in both surface and groundwater, as well as increased sediment levels in surface waters due to soil erosion.

Nitrate run-off is a substantial threat to many aquatic ecosystems globally, primarily from excess nutrients in agricultural run-off related to fertilizer use.[29] While beneficial for crop production, excess nitrogen and phosphorous in aquatic systems can lead to eutrophication, hypoxic environments and undesired algal blooms.

Pesticides may include insecticides, herbicides and fungicides. Most global pesticide use is for increasing crop production. A large variety of substances (both biological and chemical) can be involved, varying in their effects on targets, environmental toxicity, persistence and potential for bioaccumulation. Other pollutants linked with agricultural activity include pharmaceuticals and hormones used in livestock production.[30] The accumulation of pesticides and other pollutants in groundwater, surface water and soils can lead to detrimental environmental and human health impacts.[31] Note that the chapter on biodiversity includes metrics and guidance supporting the "reduced pesticides risk" outcome of regenerative agriculture.

3.3 Potential benefits of regenerative agriculture for water-related outcomes

The availability of green water (in the soil) and blue water (in groundwater or surface bodies) are key considerations for agricultural production[32] and are closely linked to soil health.[33] Soil in good condition with a high infiltration capacity absorbs and retains more green water, reducing rainfall or irrigation run-off and potential erosion risk[34,35] and supporting better replenishment of groundwater. Regenerative practices should also seek to reduce the blue water withdrawals from production systems and pressures from agricultural pollutants, to ensure production aligns with planetary boundaries and the capacity of basins to maintain environmental flows.[36]

Regenerative agriculture practices can improve the water infiltration rate and holding capacity of soils, thus positively affecting water flows and supply,[37] reducing potential soil erosion and the need for blue water withdrawals. For example, allowing the creation of litter cover benefits biocrust decomposition with a positive effect on soil quality and water absorption.[38,39] Reduction in tillage or stubble retention can reduce sediment run-off into receiving water bodies.[40,41,42] Crop rotation and diversification may also help to increase water-use efficiency and retention.[43] Riparian buffers can reduce the run-off of nutrients in many contexts.[44]

However, for many regenerative practices, the evidence base for benefits to water supply and quality remains mixed or limited, with further research needed.[45] Clearly establishing the role of regenerative agriculture requires accurate protocols for water accounting and assessing implementation.[46,47,48,49]

The metrics and *how we designed them*

04.

04. The metrics and *how we designed them*

4.1 Water sub-group on corporate metrics for regenerative agriculture

Within the RAM workstream, the water sub-group convened technical experts from 10 member and partner organizations over a four-month sprint. The objective of this sub-group was to identify metrics to support the water-related outcomes of regenerative agriculture (see Figure 1).

RAM working group participants have agreed on a set of principles to guide this work across the outcome areas (see Annex D for further principles and themes developed for this specific sub-group):

1. Ensure clarity of connection between metrics and ultimate outcomes, aligned to planetary boundaries.
2. Develop metrics that are clearly usable for companies and incorporate simple, scientific and robust agreed definitions.
3. Identify and build on synergies with the relevant existing efforts (frameworks, guidance, etc.) that measure and track metrics. This includes aligning methods and terminology with leading corporate sustainability and regenerative agriculture frameworks.
4. Ensure clarity on how data flows between farm-, landscape- and global corporate levels.
5. Consider and communicate the interconnectedness of sub-group metrics with other impact areas.
6. Focus on outcomes-oriented core metrics, which may be accompanied by intermediate (required for calculation) and additional (optional) metrics.
7. Metrics alignment supports progress on understanding and scaling success of regen-ag, not intended as prescriptive or constrictive to companies.
8. Guidance should address key considerations and guardrails for implementation including land-use change, differences across subsectors and value chains, etc.

Although covered in distinct chapters, it is important to view the metrics recommended for specific outcome areas holistically. For example, increased soil health and reduced pesticide risk can contribute to improved water outcomes. Similarly, improvements in environmental flows and water quality can support positive biodiversity outcomes. And all environmental outcomes can ultimately affect farmer livelihoods and health outcomes, to be covered in the respective chapter.

State, pressure, response framework

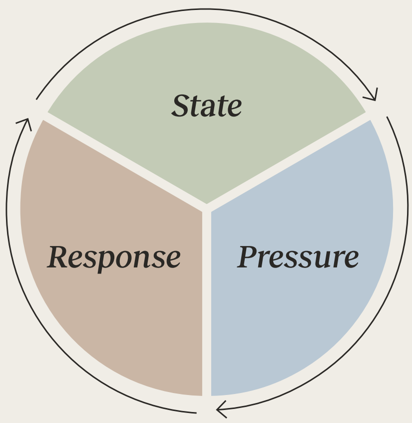
The state-pressure-response framework (Figure 3) is is commonly used to help define indicators and associated metrics for measuring impacts on the environment. Metrics of state are often considered the most reliable; however, they can be difficult to collect or attribute to company action and may be slower to change than response or pressure indicators. Thus we can also measure pressures that are influencing parameters or the responses that can reduce pressures or restore nature. Companies can use metrics of pressure where there is a strong evidence base linking pressures to changes in the environmental parameters of interest. Response metrics can provide guardrails to ensure companies meet outcomes in a scientifically-rigorous manner; however, this workstream focuses on state and pressure metrics.

State: Direct state of the environment in (i) the state of ecosystems (extent and condition), (ii) species (abundance and extinction risk) and (iii) ecosystem services (or the state of nature's contribution to people)

Pressure: Human activities that directly or indirectly change the state of the environment and ecosystem.

Response: Actions taken by companies or farmers to address pressures or to improve the state of nature on farmed land.

Figure 3: **State, pressure, response framing for water-related metrics**



Outcome: Improved environmental flows

Indicator: Blue water

Possible metrics:

- Water flow in surrounding water bodies (m3/s)
- Blue water withdrawal (m^3/ha)
- Percentage of farmed land with cover crops (%)

Outcome: Minimized water pollution

Indicator: Nutrient loss

Possible metrics:

- Concentration of N and P in receiving water bodies (mg/L)
- Nutrient use efficiency (NUE) (%)
- Percentage of farmed land with no tillage agriculture (%)

4.2 Metrics to measure the water outcomes of regenerative agriculture

We have classed metrics as either core or additional, with core as the default, minimum set to apply in all cases when reporting at the corporate scale. We also include optional metrics which may more closely measure an improved state of nature related to these pressures. Companies should not use them in place of core metrics, but rather to provide additional context where desired. Additional metrics may be more demanding to measure than core metrics but can provide valuable additional information for interpreting core metrics, demonstrating progress and informing adaptive management. Intermediate metrics are those required as inputs for the calculation of either core or additional metrics. These can be useful to disclose alongside metrics to aid in contextualizing results.

The working group has aligned on two water-related outcomes: *improved environmental flows and minimized water pollution.*

We recommend two core metrics to measure these outcomes and indicate improvement in the main pressures of agriculture on water resources (Table 1):

1. **Blue water withdrawal (split by level of water stress risk)**
2. **Nutrient use efficiency**

We have designed these metrics for use in tracking the performance and contribution of regenerative agriculture programs over time. This will help identify the contribution of regenerative agriculture to wider corporate nature goals. Companies should measure the metrics against a historical baseline which they define – for example, previous year or year the regenerative agriculture project commenced. Nature-related target-setting methods (namely from the SBTN – Freshwater targets) can be instructive in this process (see Section 5.1 and Annex E).

Table 1: Recommended water metrics – March 2024

Outcomes	Indicators	Core metrics	Additional Metrics	Type	Key links
Improved environmental flows	Blue water	**Blue water withdrawal** (m^3/ha) – split by level of water stress risk		Pressure	Biodiversity
			Blue water withdrawal (m^3/ha) aligned with environmental flows	Pressure	Biodiversity
			Water consumption or Evapotranspiration *(m^3/ha)*	Pressure	Biodiversity
	Green water		*Soil water holding capacity (%)* *([volume of water/total volume of saturated soil] x 100)*	State	Soil, climate
Minimized water pollution	Nutrient loss	**Nutrient use efficiency (%)** (Nitrogen removal [kg N/ha] / application rate [kg N/ha]) x 100 and (Phosphorous removal [kg P/ha] / application rate [kg P/ha]) x 100 Intermediate metrics: total N & P application (kg/ha)		Pressure	Biodiversity, climate
			Nutrient loss at edge of field (kg/ha)	Pressure	Biodiversity
			Loading of nitrogen (N) and phosphorus (P) to receiving water bodies (kg/month/ha)	State	Biodiversity
	Total suspended soids		*TSS of receiving water bodies (mg/L)*	State	Biodiversity

Core metrics: Recommended, aligned with disclosure requirements and key frameworks, together seek to represent the regen-ag water outcomes (may require intermediate metrics to calculate)

Additional metrics: Companies can optionally report as standalone metrics, to complement but not replace core metrics

4.3 Our process

We defined two measurable, evidence-based water-related outcomes for regenerative agriculture practices that relate to the broad sustainability objective of reducing pressures on nature from resource use and pollution: improved environmental flows and minimized water pollution.

Framework mapping and criteria assessment

To align the outcomes and metrics with existing corporate reporting requirements, we conducted:

- → A review of water-related metrics included in relevant standards and frameworks
- → An assessment of the metrics against criteria to determine their scientific evidence base, ease of measurement, affordability, accessibility and applicability

The frameworks mapping was a first step to check the initial list of metrics prioritized by the metrics sub-group against relevant frameworks for both regenerative agriculture and corporate sustainability and nature assessment, target-setting and disclosure. These include for example:

- → Sustainability frameworks: TNFD Food & Agriculture Sector Guidance, SBTN, CDP, Global Reporting Initiative (GRI), International Sustainability Standards Board (ISSB), EU Corporate Sustainability Reporting Directive (CSRD)
- → Regenerative agriculture frameworks: OP2B, Regen10 Outcomes framework v0, SAI Platform, Field to Market, Cool Farm Tool, Sustainable Markets Initiative, Textile Exchange

This initial mapping highlighted points of agreement and divergence amongst the relevant frameworks, informing recommendations among potential metrics. (Tables 2 and 3 show results for the recommended core metrics, full mapping available in Annex B.)

Table 2: Corporate sustainability framework mapping for recommended core metrics

Outcomes	Indicators	Metrics	Included in sustainability frameworks					
			CDP	CSRD	GRI-303 Water	ISSB	SBTN Freshwater	TNFD
Improved environmental flows	Blue water withdrawal	Blue water withdrawal	Intermediate	Needed	Intermediate	Voluntary	Needed	Needed
Minimized water pollution	Nutrient loss	Nutrient use efficiency (NUE)	Needed	Intermediate	Voluntary		Intermediate	Intermediate

Table 3: Regenerative agriculture framework mapping for recommended core metrics

Outcomes	Indicators	Metrics	Included in regen-ag frameworks						
			Cool Farm Tool	Field to Market	OP2B	Regen10	SAI Platform	SMI	Textile Exchange
Improved environmental flows	Blue water withdrawal	Blue water withdrawal	Needed		Needed	Voluntary	Needed	Needed	Needed
Minimized water pollution	Nutrient loss	Nutrient use efficiency (NUE)	Needed*		Needed		Intermediate	Needed	Needed

Needed metric for reporting

Intermediate metric that may needed to calculate end results

Voluntary metric, not required for reporting

Note to table 3:
*This is an output metric of the tool as part of the GHG component, not the water component of the tool.

We adapted metrics design criteria for the context of regenerative agriculture from the TNFD's criteria for assessing state of nature metrics.[50] These criteria address key points related to scientific evidence base, scalability, attribution, practical applicability for companies and potential for misuse of metrics. (Table 4 shows results for the recommended core metrics, full mapping available in Annex C.)

Table 4: Criteria assessment results for recommended core metrics

Outcomes	Indicators	Metrics	Criteria								
			Relevance to objective	Evidence base	Scalability	Generality	Breadth	Potential for stand-ardization	Potential for target-setting	Feasibility	Potential for gaming
Improved environmental flows	Blue water withdrawal	Blue water withdrawal	3	3	3	2	3	3	3	3	2
Minimized water pollution	Nutrient loss	Nutrient use efficiency (NUE)	2	3	2	2	2	3	2	2	2

0 Does not meet the criterion

1 Partially meets the criterion but has limited potential for improvement and some limited challenges/issues

2 Partially meets the criterion and has substantial potential for future improvement and some considerable challenges/issues

3 Fully meets criterion

Opportunities for *metric implementation*

05.

05. Opportunities for *metric implementation*

5.1 Target-setting

These indicators and associated metrics can provide a basis for corporate target-setting on regenerative agriculture outcomes. Defining targets or thresholds is not in the scope of this guidance chapter, but there are numerous resources to help corporates define appropriate targets, monitor and disclose progress.

Companies along the full agri-food value chain are likely to be developing targets and strategies to address impacts on nature and contribute to global goals for nature recovery (e.g., nature positive).[51] Both regulatory and voluntary corporate sustainability frameworks require (or strongly recommend) that companies set targets related to dependencies, impacts and risks, disclose them and report on progress (e.g., EU CSRD, TNFD, CDP, GRI, ISSB).[52] While some initiatives do not prescribe how targets should be set, SBTN details an approach to set science-based targets for impacts on nature that align with global goals of nature recovery and local context.[53] These are useful resources for target development and tracking.

Resources specific to water outcomes are available to help guide target and strategy development. Some or all of the of the water metrics recommended in this chapter may be relevant for these approaches.

- → *SBTN Freshwater Guidance* – Guidance for companies in setting science-based targets for freshwater direct operations and upstream activities. Includes guidance on water use and nutrient pollution target-setting.[54]
- → *Setting Enterprise Water Targets: A Guide for Companies* – Guidance on setting enterprise water targets at the local level, informed by assessment of water materiality and risks across the value chain. A toolbox is also available to help with this process.[55]
- → *Alliance for Water Stewardship (AWS) Standard v2.0 and Guidance* – Guidance on how to evaluate water-related risks, identify actions and develop a water stewardship plan for an organization or site, in the context of specific water basins. Guidance is also available on implementation, monitoring and disclosure of progress, including targets to increase water use efficiency and reduce total volumetric water use.[56]

Regenerative agriculture can play an important role as part of these strategies, helping to reduce risks and minimize the impact of production systems on nature. We recommend the outcomes and metrics presented here for use as part of wider strategies for tracking farm- and landscape-level outcomes from regenerative practices and reporting progress at the corporate scale. However, regenerative agriculture is only part of the strategy required for most organizations. Further actions will be needed to avoid, minimize, restore and compensate for impacts; and strategies should consider impacts throughout value chains and at the landscape scale.

Case Study: Regrow

Regrow combines remote sensing, environmental modeling, and enterprise technology to help companies across the agrifood value chain measure, report, and take action to advance regenerative agriculture. Regrow continuously monitors over half a billion hectares around the world, providing field-level visibility at global scale.

Regrow's science and technology offer broad based potential to promote nature-positive outcomes at landscape and farm scales, including carbon emissions removal and reduction, biodiversity, and **water stewardship.**

Regrow is advancing science and technology that enables companies to evaluate their supply sheds and implement programs to address water resource pressures, including:

- → **blue water withdrawal**
- → **irrigation & water use efficiency**
- → **nutrient & sediment loss**
- → **nutrient use efficiency**
- → **use of regenerative & water-smart practices**

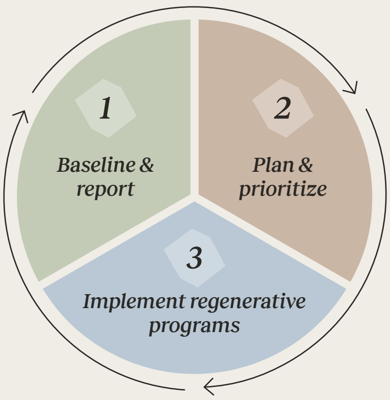
A water outcomes-based approach for sustainable food systems

Accounting and planning at landscape-scale

Fully-remote monitoring systems provide field-level metrics that can be aggregated to sub- watershed, jurisdictional, or sourcing boundaries.

1. Baseline & report

- → **Baseline & report** annual water withdrawal, nutrient loss, and input efficiency in supply sheds; or sourcing from water stressed areas
- → **Identify risks** where pressures are high in sourcing regions with significant water stress or pollution
- → **Monitor** change in practice adoption & pressure metrics over time



2. Plan & prioritize

- → **Set or update targets** for water use & pollutant runoff reductions that are locally relevant and feasible
- → **Identify opportunities** to meet water targets or source more sustainably
- → **Plan & prioritize supply shed programs** where they will benefit water resources & producers the most

Taking action and measuring progress at farm-level

Producer-supplied activity data, in combination with remote inputs, enable measurement and reporting of verified outcomes at the field or operation scale for incentive programs

3. Implement regenerative programs

- → **Measure and verify** annual water withdrawal and nutrient use efficiency on fields and operations of producers that voluntarily enroll in regenerative agriculture programs
- → **Provide financial incentives** to producers for reducing water use or nutrient loss, or for achieving input efficiency benchmarks
- → **Track and report** program-level changes over time, and integrate outcomes into supply shed-level accounting and planning

Source: https://www.regrow.ag/

5.2 Remaining gaps and challenges

Improved data for measuring impacts on water quality and environmental flows

There is a range of resources and datasets available to help measure outcomes of regenerative agricultural practices (see Annex E). However, there are also large uncertainties and challenges in accessing data across different basins and farming contexts. Improved basin-level data on water quality and environmental flows are vital to helping companies prioritize efforts to improve practices, understand trade-offs and risks and monitor outcomes effectively and efficiently.[57] Where companies consider direct measurement infeasible, they may use proxy measures as a first step toward more rigorous measurement and reporting.

Limited evidence base for many practices

There is often a good evidence base for the outcomes of many regenerative practices to benefit water quantity and quality at a field or farm level. For example, the implementation of riparian buffers can improve water quality in many farming contexts.[58,59] However, the evidence base is sometimes mixed or limited. Further work is needed across research and agri-business communities to build the evidence base for regenerative practices in different contexts. A solid evidence base for the effectiveness of specific practices is essential when deciding to measure responses in place of pressure or state indicators, which can be more costly and time consuming to assess.

Understanding trade-offs between yield and environmental gains

As highlighted as a key guardrail for the use of these metrics (Annex D), yield and production statistics are important to consider when transitioning to regenerative practices. In some cases regenerative agriculture may lead to yield increases[60] (possibly more often in the long term than in the short term). However, this is difficult to test given inconsistencies thus far in defining regenerative agriculture. Given documented crop yield stagnation under conventional practices, an understanding of the potential impacts of regenerative agriculture practices on yield is an important research area,[61] including the need for more field references in different contexts. The RAM workstream seeks to align on a holistic set of metrics across environment, social and economic categories. The socio-economic sub-group will consider yield- and income-related metrics.

Interoperability of standards and frameworks

There is a clear need for a high degree of interoperability and connectivity with existing frameworks and platforms, including standards, reporting and disclosure. This work seeks to align and drive the incorporation of regenerative agriculture into these systems to strengthen corporate performance accountability systems for carbon, nature and equity.

Limitations for implementation

This guidance outlines a set of indicators and associated metrics that companies can apply generally across many agricultural contexts to show progress on desired regenerative outcomes. A standardized set of metrics facilitates consistent measurement, comparisons and aggregation. However, the great diversity of potential contexts, in relation to a location's ecology, climate, geology, history, target products, management and landscape setting, mean that a one-size-fits-all approach inevitably has limitations. Many other indicators and metrics are potentially relevant or might be more practical or robust in specific contexts.

Notably, some metrics may have more limited application in specific agricultural contexts (for example they may be fewer that are applicable in grazing systems compared to row crops). Similarly, smallholder farmers may lack the technical and financial resources needed to measure and report on farm-level metrics. When there are such discrepancies and challenges, companies should report relevant metrics alongside an explanation of why they may be limited in applicability or feasibility.

Case study: Nutrien

In 2022, six organizations spanning food, agriculture and environmental interests began collaborating on a pilot project with four farms growing potatoes, grains and oilseeds on 14,000 hectares in Manitoba, Canada, to explore how improved water stewardship practices can deliver value on and off the farm. The project partners (ALUS Canada, BASF, General Mills, Nutrien, Simplot and the Water Council) provided participating farmers with technical support and resources to develop detailed water stewardship plans for their operations. The farmers in turn identified existing practices and explored additional actions, while broadening their knowledge of water stewardship and the connections their activities have to the watershed and surrounding communities. Initial results indicated that full implementation of water stewardship plans would provide improved outcomes linked to key aspects of regenerative agriculture: soil stabilization, reduced nutrient runoff, increased water availability, enhanced biodiversity and a more stable rural economy. As the project moves into the next phase, project partners anticipate implementing water stewardship plans with farmers and evaluating environmental, social and economic outcomes. This will continue to build the business case for on-farm water stewardship investment that enables multiple co-benefits, including driving regenerative outcomes in the agri-food value chain.

"There's more and more push from the public to have food sustainability. Therefore, we are seeing more push from buyers to have us, the farmers, participating in programs such as this as a sort of 'record' to show what good we are doing. We want to stay ahead of the curve and be proactive."

— Chad Berry Owner and Operator Under the Hill Farms

Source: https://alus.ca/alus_news_and_events/water-stewardship-planning-finds-value-for-farmers/

Next steps to *accelerate the transition to regenerative agriculture*

06.

06. Next steps to accelerate *the transition to regenerative agriculture*

The ultimate objective of this work is to enable companies to measure and report on the main outcomes of regenerative agriculture. The concept of nature – as the enabler of life on Earth and our social and economic systems – underpins our holistic approach to measuring regenerative agriculture. To date, this working group has published recommended metrics for climate- and water-related outcomes.

Our work with OP2B on regenerative agriculture metrics aims to address common pain points in the system relating to "measure and manage performance". Aligning on a common set of indicators to measure the outcomes of regenerative agriculture will lead to outcomes that align, incentivize and accelerate progress on nature targets (as well as net-zero emissions and equity-related targets) and secure the necessary financing to propel the transition by cultivating transparency.

In 2024, WBCSD and OP2B will continue to facilitate the system-wide transition to regenerative agriculture as part of the broader drive for corporate performance and accountability on climate, nature and equity, as well as action at landscape level and enabling environment. This includes:

Accountability

- Framing regenerative agriculture outcomes and metrics within the broader context of sustainable land-use, as outlined in the Nature Positive Roadmap for the agri-food system;[62]
- Engaging with the relevant standard-setting bodies (including the Task Force on Climate-related Financial Disclosures (TCFD), TNFD, SBTN, GHG Protocol, CSRD, Science Based Targets initiative Forests, Land and Agriculture (SBTi FLAG) Guidance, CDP and others) to support 1) alignment on metrics that are scientifically robust and practical for corporate use and 2) guidance for implementation (on materiality, value chains, data challenges and more).

Landscape action

- Clarifying the financing needs and opportunities to de-risk farmers' transition to regenerative agriculture in Europe and another smallholder farm archetype. In Europe, this includes identifying opportunities for co-investment, building on the existing business case.[63] In addition, the work includes understanding costs of the transition and demonstrating the business case in a smallholder farm archetype.
- Catalyzing public-private investment opportunities by convening roundtables to bring to light public/private investment opportunities for a large-scale landscape project feasibility study.
- Supporting comprehensive farmer financing mechanisms by developing a guide on investment options to de-risk farmer transitions to regenerative agriculture.
- Supporting the COP28 Action Agenda on Regenerative Landscapes, which aims to aggregate, accelerate and amplify existing efforts and new commitments to transition large agricultural landscapes to regenerative landscapes. In 2024, the Action Agenda aims to advance the mapping of existing and planned regenerative landscape efforts. It will do this by brokering partnerships across the food and agriculture value chain, with financiers and the public sector, and communicate efforts and results to amplify the landscape approach and mobilize additional action.

Enabling

- Driving awareness of the regenerative agriculture business case in policy by improving positioning it in global fora (CBD COP16, New York Climate Week, the European Union, etc.).
- Financing regenerative landscape projects by developing clear policy asks on blended funding for regenerative landscapes, laying the groundwork for a public- private partnership in Europe.
- Aligning a strong position for regenerative agriculture in upcoming EU policy.

It is important to note that the leading nature-related and regenerative agriculture corporate frameworks – and the scientific methodologies and data which underpin them – continue to evolve and improve. Users should see this work as a starting point to help align industry with the regenerative agriculture outcomes and metrics that are likely to be developed and improved in the future. We will revisit our recommendations periodically to keep up with the latest developments.

Annex A:
Glossary

Taxonomy

Impacts

Ultimate state of nature effects sought.

Indicators

Values or characteristics that provide insight into a particular phenomenon or situation.

Metrics

System or unit of measurements.

Outcomes

Quantitative or qualitative parameters that measure achievement or reflect changes over time; may be short or long term.

Nature-related

State of nature

Refers to measures of the direct state of the environment in three categories: the state of ecosystems (extent and condition), species (abundance and extinction risk) and ecosystem services (or the state of nature's contribution to people).[64]

Pressure

Human activities that directly or indirectly change the state of the environment and ecosystem. Following the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES),[65] five key pressures contribute most to the loss of nature globally: land- and sea-use change; direct exploitation of organisms; climate change; pollution; and invasion of alien species.[66]

Response

Actions taken by companies or farmers to address pressures or to improve the state of nature on farmed land.

Water-related

Blue water

Rivers, lakes, reservoirs and renewable groundwater stores.[67]

Green water

Terrestrial precipitation, evaporation and soil moisture.[68]

Water withdrawal

Sum of all water drawn from surface water, groundwater, seawater or a third party for any use over the course of the reporting period.[69]

Water consumption

Sum of all water withdrawn and incorporated into products, used in the production of crops or generated as waste, has evaporated, transpired or been consumed by humans or livestock, or is polluted to the point of being unusable by other users and is therefore not released back to surface water, groundwater, seawater or a third party over the course of the reporting period.[70]

Water discharge

Sum of effluents, used water and unused water released to surface water, groundwater, seawater or a third party, for which the organization has no further use, over the course of the reporting period.[71]

Environmental flows

The quantity, timing and quality of water needed for functioning ecosystems.[72]

Total suspended solids (TSS)

The overall mass of particles suspended in a water sample. The TSS are usually captured by a filter during sampling. This is distinct from total dissolved solids, which measures the dissolved fraction.[73]

Annex B:
Alignment of water metrics with key frameworks

Table 5: Alignment of water metrics considered with key sustainability frameworks

Outcomes	Indicators	Metrics	Included in sustainability frameworks					
			CDP	CSRD	GRI-303 Water	ISSB	SBTN Freshwater	TNFD
Minimized water pollution	Nutrient use efficiency	**Nutrient removal / Nutrient input) x 100 (%)**	Needed		Voluntary		Intermediate	Voluntary
	Freshwater quality	Sediment and pollutant loads	Needed		Voluntary	Voluntary	Needed	Voluntary
		TSS receiving water bodies (mg/l)			Voluntary	Voluntary		
		Load of nitrogen (N) and phosphorus (P) to receiving water bodies (kg/ha/month)	Needed		Voluntary	Voluntary	Needed	Needed
		Water pollution indicator species						
	Wastewater management		Needed		Needed		Intermediate	Needed
Improved environmental flows	Riparian area buffer	*% of riparian area buffer (minimum width required)*					Intermediate	
	Blue water withdrawal	**Blue water withdrawal (l/ha)**	Intermediate	Needed	Intermediate	Voluntary	Needed	Voluntary
		Freshwater withdrawals from surface water bodies and groundwater (l/ha)	Needed	Needed	Intermediate	Voluntary	Needed	Voluntary
		Water extracted for irrigation (l/ha)	Needed	Needed		Voluntary	Needed	Voluntary
	Irrigation efficiency	Water used by crops/total water applied (%)	Needed					
	Water productivity (WP)	Crop yield / liter water consumed	Needed					

Intermediate metric that may needed to calculate end results

Voluntary metric, not required for reporting

Needed metric for reporting

Table 6: Alignment of water metrics considered with key regenerative agriculture frameworks

Outcomes	Indicators	Metrics	Included in sustainability frameworks						
			Cool Farm Tool	Field to Market	OP2B	Regen10	SAI Platform	SMI	Textile Exchange
Minimized water pollution	Nutrient use efficiency	**Nutrient removal / Nutrient input) x 100 (%)**			Needed		Intermediate	Needed	Needed
	Freshwater quality	Sediment and pollutant loads		Intermediate		Needed	Needed		Needed
		TSS receiving water bodies (mg/l)				Needed	Needed		
		Load of nitrogen (N) and phosphorus (P) to receiving water bodies (kg/ha/month)		Intermediate		Needed		Needed	Needed
		Water pollution indicator species				Needed			
	Wastewater management								
Improved environmental flows	Riparian area buffer	*% of riparian area buffer (minimum width required)*				Needed			Needed
	Blue water withdrawal	**Blue water withdrawal (l/ha)**	Needed		Needed	Voluntary	Needed	Needed	Needed
		Freshwater withdrawals from surface water bodies and groundwater (l/ha)	Needed		Needed		Intermediate	Needed	Needed
		Water extracted for irrigation (l/ha)	Needed	Intermediate	Needed		Intermediate	Needed	Needed
	Irrigation efficiency	Water used by crops/total water applied (%)	Needed*	Needed					Needed
	Water productivity (WP)	Crop yield / liter water consumed	Needed*	Needed			Intermediate		Needed

Needed metric for reporting

Intermediate metric that may needed to calculate end results

Voluntary metric, not required for reporting

Notes to tables 5 and 6:

- → This is the initial mapping exercise; metrics have evolved over the course of the work
- → We have included those **bolded**, or a form of them, in the final metric set. We have included those *italicized*, or a version of them, in the biodiversity metrics.
- → GRI-303: Water quality included if identified as a material risk.
- → Field to Market (water quality and irrigation water use): Water quality is a modelled score based on risk of sensitivity to water quality issues and management practices. Riparian buffers are a weighting factor in their biodiversity metric. Blue water withdrawal is used in the water productivity metric.
- → *These are output metrics of the Cool Farm Tool water component.

Annex C:
Metrics criteria assessment

WBCSD's technical partners first developed a set of metrics criteria against which to evaluate each potential metric:

Metric criteria	Explanation
1 Relevance to objective	Is the metric likely to drive effective change in the right direction
2 Evidence base	Is the evidence base linking metric to objective adequately robust
3 Scalability	Can the metric be aggregated across farm, landscape, corporate scales
4 Generality	Can the metric be applied meaningfully in all geographic and agricultural contexts (either in a single version or in biome/subsector variants)?
5 Breadth	How fully does the metric cover the relevant sub-objective/indicator – would it need supplementing with other metrics in order to fill gaps?
6 Potential for standardization	Can the metric methodology be clearly defined and standardized for consistent application [also relates to verification]
7 Potential for target-setting	Is the metric amenable to defining baselines and targets
8 Feasibility	Are effort/cost/capacity requirements compatible with widespread implementation
9 Potential for gaming or creating perverse outcomes	Are there significant risks that the metric could be misleading or misapplied, resulting in undesired outcomes, absent? This includes if the metric is likely to be attributable or responsive to farm level changes.
10 Alignment	How well aligned is the metric with existing reporting frameworks?

We then scored each potential metric based on how well they met these criteria, as follows in Table 7.

Table 7: Scoring of potential metrics based on how well they meet the criteria

Outcomes	Indicators	Metrics	S/P/R	Criteria								
				Relevance to objective	Evidence base	Scalability	Generality	Breadth	Potential for stand-ardization	Potential for target-setting	Feasibility	Potential for gaming
Minimized water pollution	Nutrient use efficiency	**Nitrogen removal (kg N/ha) / application rate (kg N / ha) x 100**	Pressure	2	3	2	2	2	3	2	2	2
	TSS of bordering water bodies	**TSS in receiving water bodies (Mg/L)**	State	3	3	1	2	3	3	1	3	1
	Freshwater quality	*% of farms using hazardous chemicals*	Pressure	3	3	2	2	2	1	2	3	2
		Load of nitrogen (N) and phosphorus (P) to surface water bodies (kg/ha/month)	Pressure	3	3	3	1	2	3	3	2	2
		Average % of priority water pollution indicator species present at farm site	State	2	2	1	2	1	0	2	1	1
	Riparian area buffer	*% of riparian area buffer (minimum width required)*	Response	2	2	1	2	2	3	3	3	3

0 — Does not meet the criterion

1 — Partially meets the criterion but has limited potential for improvement and some limited challenges/issues

2 — Partially meets the criterion and has substantial potential for future improvement and some considerable challenges/issues

3 — Fully meets criterion

Table 7: Scoring of potential metrics based on how well they meet the criteria *(continued)*

Outcomes	Indicators	Metrics	S/P/R	Criteria								
				Relevance to objective	Evidence base	Scalability	Generality	Breadth	Potential for stand-ardization	Potential for target-setting	Feasibility	Potential for gaming
Improved environmen-tal flows	Blue water withdrawal	Blue water withdrawals from surface bodies and groundwater - m³/ ha	Pressure	3	3	2	1	3	3	3	3	2
		Blue water withdrawal m³ / ha - split by level of water stress risk (based on tools such as the WWF risk filter)	Pressure	3	3	3	2	3	3	3	3	2
		Blue water withdrawal m³ / ha - split by source including groundwater & surface water	Pressure	3	3	2	1	3	3	3	2	2
		Water consumption (m³ / ha)	Pressure	3	2	2	1	2	2	2	1	2
	Irrigation efficiency	Water used by crops / total water applied (%)	Pressure	1	1	1	1	2	1	1	1	1
	Water productivity (WP)	Crop yield / liters of water consumed	Pressure	2	1	2	1	1	1	1	3	2
	Soil water holding capacity	**% ((volume of water / total volume of saturated soil) x 100)**	State	3	2	2	2	2	2	1	2	3

- 0 Does not meet the criterion
- 1 Partially meets the criterion but has limited potential for improvement and some limited challenges/issues
- 2 Partially meets the criterion and has substantial potential for future improvement and some considerable challenges/issues
- 3 Fully meets criterion

Notes to table 7:

→ This is the initial mapping exercise; metrics have evolved over the course of the work
→ We have included those **bolded**, or a form of them, in the final metric set. We have included those *italicized*, or a version of them, in the biodiversity metrics.

Annex D:
Technical discussion of recommended metrics

Principles

Note that the nature-related sub-groups (on water, biodiversity and soils) have aligned around further points to support the general principles outlined, including:

- → Importance of local context;
- → Spatial scope is farm boundary, unless otherwise noted;
- → Metrics can refer to nature-related pressures provided there is a clear evidence base linking to improved state of nature;
- → Consider sub-sector differences (e.g., row crops vs grazing);
- → Build in flexibility to adapt recommendations as frameworks and science continue to evolve.

The water metrics sub-group further identified key themes of relevance, to complement the principles common across the broader exercise, including:

- → Aim for positive basin-level impacts with strong evidence base linking to field-level interventions.
- → Apply universal metrics and guidance within the context of basin-level sustainability (both water availability and water quality & links between).
- → Consider impacts for all stakeholders in a basin: agriculture, communities, ecosystems, industry.

Outcome: Improved environmental flows

Blue water withdrawal and consumption

- → Type of metric: pressure
- → Spatial scope: farm boundary
- → Temporal scope: annual or more frequent
- → Key links to other metrics: biodiversity

Blue water withdrawal and consumption are key indicators of pressure from agricultural systems. Blue water withdrawal measures the extraction of water for agricultural use from the environment per hectare, including both surface and groundwater resources. There is a strong evidence base for the need to reduce blue water withdrawals from agricultural systems to stay within planetary boundaries. The metric is feasible to calculate, aligned with many regenerative agriculture and corporate reporting frameworks, scalable and amenable to target-setting. Blue water consumption is calculated as the water used in the production of agricultural products and so accounts for the fact that some water withdrawn may enter back into the surrounding water bodies.

The environmental impacts of withdrawal are specific to a given basin, so it is important to report water withdrawals according to water stress risks and, if possible, how they align with basin-level environmental flows. We recommend the baseline water stress (BWS) metric as a widely used, high-level, globally applicable indicator of basin-specific water stress risk. BWS measures the ratio of total water demand to available renewable surface and groundwater supplies in a given basin, as used in the WRI Aqueduct Water Risk Atlas tool.[74]

Corporate reporting frameworks often require information on water withdrawn, consumed and discharged. Consumption may be a more accurate measure than withdrawal of pressure on environmental flows but estimating consumption (including evapotranspiration calculations) can be complex in agricultural settings and does not account for changes in quality of withdrawn water quality. Hence, we've included consumption as an additional metric. Frameworks also often require the splitting of withdrawals and discharges by the source of water (e.g., surface and groundwater). The metrics proposed here would be suitable for this subdivision if required.

Although widely used for reporting outcomes, these metrics may not be equally applicable to all forms of agriculture and this should be considered when interpreting data. Notably, irrigated and non-irrigated systems will present very different profiles in terms of blue water withdrawals; a non-irrigated system would likely report no blue water withdrawals (even if they indirectly influence blue water resources). While the core metric is applicable for grazing and industrial systems, we recommend reporting additionally the embedded water use in animal feed (as per Science Based Targets Network (SBTN)-Freshwater guidance) when the metric is used for livestock systems.

Corporate reporting frameworks provide guidance for assessing water withdrawals and consumption (e.g., Global Reporting Initiative (GRI) and Taskforce on Nature-related Financial Disclosures (TNFD)). Tools that can support assessment of water stress levels include World Resources Institute (WRI) Aqueduct, WWF Water Risk Filter and EarthStat Water Depletion layer (Annex E). The Science Based Targets Network (SBTN) Freshwater Guidance provides information on target-setting for freshwater water withdrawals aligned with environmental flows within specific basins, important to ensure basin flows are maintained for human needs and environmental function. Tools such as WaterStat and the Cool Farm Tool can help assess the water footprint of crops and livestock production systems. The Water Footprint Assessment Manual provides guidance on assessing overall water use embedded in products and on estimating consumption of blue and green water.

Soil water holding capacity (SWHC)

- Type of metric: state
- Spatial scope: farm boundary
- Temporal scope: annual or more frequent
- Key links to other metrics: soil, climate

Green water availability – including terrestrial precipitation, evaporation and soil moisture – is a key component of soil health and of the water requirements for many arable and pastoral agricultural systems, not captured through the pressure metrics on blue water withdrawal and consumption. Soil water holding capacity provides an indication of the ability of soil to maintain water resources and is influenced by the structure and organic matter contents of the soil. It provides information on a component of soil health – a key objective of regenerative agriculture – and its capacity to provide crops with access to green water. This metric also links to the reduced pollution outcome as a result of reduced nutrient and pesticide runoff from improved SWHC. Measuring SWHC is relatively simple at a field level but providing this data from farms across many different contexts may be challenging. Reference levels may be hard to judge depending on the type and condition of soils available. Hence soil water holding capacity is included as an additional metric. Core metrics related to soil carbon are to be included in the soil metrics, which will link to water holding capacity. There are various methods for measuring SWHC, some of which can be simply calculated).[75] A common related metric is soil infiltration rate, which, although not included here, can help assess likelihood of soil erosion, capacity of crops to access green water, as well as the physical structure of soils.

Disclosure examples for annual reporting:

- Core: Blue water withdrawal annually
  - x m^3/ha in basins of extremely high BWS; y m^3/ha in basins of high BWS; x m^3/ha in basins of medium-high BWS; y m^3/ha in basins of low-medium BWS; x m^3/ha in basins of low BWS
- Additional: Blue water withdrawal aligned with environmental flows
  - x m^3/ha withdrawn per month above company science-based targets for freshwater withdrawal
- Additional: Water consumption or evapotranspiration annually
  - x m^3/ha of water consumed
- Additional: Soil water holding capacity
  - x %

Outcome: Minimized water pollution

Nutrient use efficiency (NUE)

- Type of metric: pressure
- Spatial scope: farm boundary
- Temporal scope: annual or more frequent
- Key links to other metrics: biodiversity, climate

Nutrient use efficiency (NUE) is a pressure metric related to nitrogen (N) and phosphorous (P) pollution into surrounding water bodies, a major negative impact of agricultural production on water quality. Large improvements in NUE are needed to ensure production systems do not traverse planetary boundaries.[76] NUE is calculated by dividing an estimate of N and P removed through crop production by the nutrient application rate, including both synthetic and organic fertilizers, as well as manure in livestock systems (where no fertilizer is applied, this would require data on the existing nutrients naturally available in the soil). NUE is a simple metric of pressure, frequently used and responsive to company action, scalable and linked to nutrient concentrations in receiving water bodies. It provides an indication of likely pressure on surrounding water bodies, where a higher NUE likely indicates lower loss of nutrient inputs into surrounding water bodies. However, because NUE is expressed as a ratio, increasing efficiency may not lead to a reduction in overall pressure if the overall inputs of fertilizers also increase. Similarly, a low NUE at field level can be a result of yield-limiting events such as drought, insect and disease damage or hail, leading to a loss of yield without any effect on the level of nutrient uptake by the crop. Thus, reporting total N and P as part of the calculation is important to prevent changes in efficiency masking increases in overall inputs. Care is also needed in interpretation, as it may be more appropriate to use nutrient surplus (i.e., 1-NUE) or soil nitrogen balance (kg N/ha) for reporting in some agricultural contexts such as grazing and industrial livestock systems.

This annex links to frameworks that provide information on the calculation of NUE. Guidance on calculation can be found in other regenerative agriculture frameworks and corporate reporting initiatives (see Textile Exchange, One Planet Business for Biodiversity (OP2B), Biodiversity Monitor). Data on nutrient concentrations in crops can be used to help estimate NUE.[77]

Nutrient loss at the edge of field or loading into receiving water bodies

- Type of metric: pressure/state
- Spatial scope: receiving water body downstream from point and non-point sources, ideally in close proximity to farm boundary
- Temporal scope: annual or more frequent
- Key links to other metrics: soil, biodiversity

Assessing nutrient loss at the edge of field or loading into receiving water bodies provides a more robust indication of pressure and is applicable to a broader range of farming contexts but can be more challenging to calculate and attribute to company action. SBTN guidance describes methods using locally developed models for non-point source pollutants to estimate N and P loading rates over a five-year period. The forthcoming Water Quality Benefit Accounting guidance from WRI provides methodologies for companies to assess impacts on water quality, including calculating unit area loading rate, applicable for a range of different pollutant types.

While NUE and nutrient loading capture key aspects of water quality, agriculture also impacts other aspects of water quality not captured by these metrics, including pesticide toxicity (captured in the biodiversity metrics), sediment levels through soil erosion, heavy metals, microplastics and others. Companies and farmers may identify additional pollutants they wish to track and report if they are considered material to them and/or their stakeholders.

Total suspended sediments (TSS)

- Type of metric: pressure
- Spatial scope: farm boundary or receiving water body downstream from point and non-point sources, ideally in close proximity to farm boundary
- Temporal scope: annual or more frequent
- Key links to other metrics: biodiversity

Total suspended sediments (TSS) is a frequently used metric that captures a key component of water quality. It can be easily measured on farm using standardized methods, captures a key pressure on water bodies exerted from agricultural systems and aligns with certain regenerative agricultural frameworks (e.g., SAI platform). Standardized methods include those proposed in ISO 11657[78] and ASTM International's Standard Test Methods for Determining Sediment Concentration in Water Samples (D3977-97).[79] A drawback with TSS as a farm-level indicator is that changes in TSS in surrounding water bodies can be difficult to attribute, responsive not only to changes on-farm but to management practices in the surrounding basin. Thus this metric has been included as an additional metric and the connection to wider landscape trends should be considered when interpreting results. This metric links strongly with the metrics proposed for the soil outcome working group.

Disclosure examples for annual reporting:

- Core: Nutrient use efficiency over annual crop cycle
  - N = x% NUE (application rate = x kg/ha)
  - P = y% NUE (application rate = y kg/ha)
- Additional: Nutrient loss at edge of field over annual crop cycle
  - N = x kg/ha
  - P = y kg/ha
- Additional: Loading of nutrients to receiving water bodies
  - N = x kg/month/ha
  - P = y kg/month/ha
- Additional: TSS of receiving water bodies
  - x mg/L

Additional technical notes

Links to other metrics and environmental outcomes

These indicators and metrics aim to capture the major impact pathways through which agricultural activities influence environmental flows and water quality. Some pathways that impact water resources and water-related environmental outcomes are captured in other topic chapters:

- Pesticide pollution may affect water quality but can also be highly damaging to some components of biodiversity in the farmed landscape and in receiving water bodies. The pressures caused by pesticide use are therefore captured in the biodiversity metrics, separately for land-based biodiversity and through indicator species for water (see below).
- Certain freshwater species (for example macroinvertebrate groups such as dragonflies or caddis flies) are often used to indicate changes in water quality. However, such metrics are difficult to standardize across diverse geographies and farming contexts and, if too much flexibility is allowed, could be misused. Such species are also key components of freshwater biodiversity, so indicator species are captured as an additional metric under biodiversity.
- Soil water-holding capacity is included here as an additional metric to capture green water as an indicator of water quantity. It is also very relevant to soil health. Other metrics relevant to soil water-holding capacity (e.g., soil carbon) are captured in the soil metrics.

- There is a range of practices from regenerative agriculture that can be expected to indirectly reduce pressure on water resources. These response metrics (e.g., extent of riparian buffers, cover crops, intercropping) are not included here but feature in the biodiversity metrics.

For the pressure metrics included here, there is a clear link between changes in those pressures and expected changes in the state of water resources. Directly assessing state measures for water quantity and quality can be challenging and resource intensive. It may also be difficult to attribute findings to actions in individual farms, as in many cases upstream inputs in the wider hydro-basin will influence both baseline levels and trends over time. Attribution and interpretation of state metrics such as TSS can be more meaningful if measures are made at different points in space (i.e., upstream and downstream of the focal farm).

Aggregating metrics

Metrics measured at the farm level can be aggregated straightforwardly to other scales, such as for all operations within a defined landscape, hydro-basin or region; all operations producing a particular commodity; or to corporate level. Farm-level measures should be weighted by farm area (or the area over which measurements have been made) when averaging, to ensure an appropriate proportional contribution to the aggregate value from different-sized farms. Aggregate values expressed as ratios or percentages should also be contextualized by providing total quantities (e.g., total area, nutrient application, water volume, etc.).

Temporal considerations

Companies should measure the metrics against a historical baseline which they define – for example, previous year or year the regenerative agriculture project commenced. For some metrics (e.g., TSS, blue water withdrawals) temporal variation in measurements is expected based on seasonal changes and varying weather conditions. Metrics should be collected over timeframes appropriate to incorporate such variation and allow meaningful comparisons and assessment of trends. It is also important to be aware of these influences, to help interpret short-term changes in metrics and assess long-term trends that may be more responsive to regenerative practices on farm. Many of the metrics are amenable to reporting annually in line with corporate sustainability disclosure cycles but could be reported over longer or shorter timeframes, i.e., to reflect seasonal or short-term changes in outcomes.

Thresholds for metrics

The purpose of this guidance is not to define thresholds for target-setting related to each metric and indicator. However, defining such thresholds will be useful as companies push to develop targets for regenerative agriculture and broader nature strategies that align with global sustainability targets. It will be important to factor in agronomic feasibility and potential trade-offs in these considerations.

There are various resources under development to help define appropriate thresholds and set compatible targets. For example, the SBTN Freshwater guidance can support target development for freshwater withdrawals aligned with ecological thresholds in different basins. Similarly, research is ongoing to help assess potential thresholds for framing water quality targets. For example, the FAOSTAT database[80] serves as a global reference for cropland nutrient budgets, while the EU Nitrogen Expert Panel has proposed a safe operating range for nitrogen management that can be tailored to different locations and crop systems.[81] And recent research has suggested that current crop production could be compatible with global nitrogen planetary boundaries at an NUE of 77% (and under a balanced-diet scenario, this could be reduced to 60% to be compatible with a range of N indicators for planetary boundary transgression).[82]

Guardrails for appropriate use of metrics

Viewing the metrics and outcomes from regenerative agriculture as a whole

As highlighted above, it is important to view regenerative outcomes, indicators and metrics holistically. Metrics that are not heading in the desired direction are a prompt for further investigation, followed by adaptive management to change practice if required. It may be that actions are not having the desired consequences, that the practice or the indicator is not appropriate for the specific agricultural context, or that practices have positive effects for some outcomes but negative ones for others.

Yield and economic returns are vital contextualizing metrics

For many regenerative practices, there is a good evidence base showing benefits to water quantity and quality at a field or farm level.

Practices may also lead to improvements in long-term yield of agricultural production. However, in other cases, yields could decrease, particularly in the initial years of transition. When considering outcomes at the corporate scale, it is important to view yield measures alongside environmental metrics to highlight potential socio-economic benefits or displacement effects. Note that the chapter on livelihoods covers metrics and guidance supporting socio-economic outcomes of regenerative agriculture.

Metrics: limitations and variations

Individual metrics may not reflect all facets of the indicators and outcomes they are linked to and it is important to consider this when interpreting results. For example, water consumption can indicate impacts on water availability in a basin but needs to be interpreted in the light of overall water stress and does not account for potential changes in water quality when used on farm.

Similarly, nutrient use efficiency, as a proxy for nutrient loss at field edge, provides a measure of pressure on water quality in a basin. Increasing NUE shows that the proportions of nutrients lost are decreasing but must be interpreted in the light of total nutrient inputs. Nutrient application, in turn, should be interpreted within the context of variations in weather and changes in cropping systems, which can affect total N and P applied.

Some metrics may be limited in application in some agricultural contexts. For example, blue water withdrawal may be less suited to some forms of livestock production. When there are such discrepancies, the metrics should be reported alongside an explanation of why they are limited in applicability.

Different organizations use the many variations of these metrics; for example, some companies historically have reported agricultural water use in terms of production (tons) rather than spatially (hectares). We recommend the standardized approach outlined here – particularly for the core metrics – but recognize there are likely to remain variations on these metrics in use.

Landscape and supply chain considerations

The recommended spatial scope for measuring and reporting nature-related metrics is the farm boundary, unless otherwise noted. But nature-related metrics must be interpreted in light of the wider landscape or hydro-basin context, for example water withdrawals, levels and changes in levels of dissolved solids or nutrients in receiving water bodies.

The metrics outlined here focus on the farm-level and do not generally consider the embodied impacts of farm inputs upstream in the supply-chain. If changes are made in the source or type of inputs used, e.g., for fertilizer, changes in the consumption or pollution of water in the production process may also be considered as context for interpreting metrics on-farm.

It is also important to consider how outcomes of actions on farms may vary depending on wider landscape trends. For example, the placement of natural and semi-natural habitat within the landscape may have differing biodiversity benefits dependent on how connected it is to habitat outside of the farm (note that we cover this topic under the biodiversity metrics).

Annex E:
Key resources

Regenerative agriculture frameworks	
Biodiversity Monitor for the Dairy Farming Sector	A joint initiative of FrieslandCampina, Rabobank and the Dutch chapter of the World Wide Fund for Nature (WWF Netherlands) which aims to quantify biodiversity results to reward dairy farmers through supply chain partners and other stakeholders.
Cool Farm Tool	The Cool Farm Tool is a farm management software that allows a farmer to calculate their GHG emissions based on simple data entry on their farm. There is also a tool to calculate water use and impacts, as well as for biodiversity. The water module, requires inputs on farm characteristics, soil type, crop grown and water sources and irrigation used. It then computes water use statistics for the user.
Field to Market Sustainability Metrics Overview Documentation	This initiative is used to help farms assess their sustainability performance using a series of indicators across various environmental themes. Field to Market have metrics for biodiversity, land use, soil conservation, water irrigation use, water quality and carbon emission.
OP2B Framework for Regenerative Agriculture	OP2B is an international, cross-sectoral and action-oriented business coalition on biodiversity with a specific focus on regenerative agriculture. In 2021, OP2B with its members and partners proposed an initial set of four objectives and eight indicators for measuring progress on regenerative agriculture.
Regen10 Zero Draft Outcomes-Based Framework	Regen10 is a global endeavor committed to achieving regenerative outcomes for people, nature and climate. When complete, the framework will provide a holistic set of outcomes, indicators and metrics to understand and measure change that happens over time on farms and across landscapes.
SAI Framework for Regenerative Agriculture	This initiative aims to drive alignment around the use and measurement of regenerative agriculture practices. It defines 4 impact areas: soil health, water, biodiversity and climate. Criteria within these are then used to identify the most "material" risks for a given farm/organization. It identifies 10 outcome metrics to measure progress against the four impact areas. It then provides a list of practices for use to help deliver against these impact areas, which should be monitored to assess progress.
Sustainable Markets Initiative	A taskforce assigned to help scale regenerative farming. It has identified four levers to create change: A) funding, re-risking and new sourcing models, B) priority common metrics for environmental outcomes, C) government policy requirements to reward farmers for transition and D) ways to make environmental outcomes pay. Priority metrics include: GHG emission factors, soil organic carbon, natural and restored habitat in agricultural land, blue water withdrawal and nitrogen use efficiency.
Textile Exchange Regenerative Agriculture Outcome Framework	This framework helps the fashion, textile and apparel industry align on outcomes for regenerative agriculture by providing a range of farm and corporate level metrics. The farm-level outcomes are split into those related to social and economic equity (e.g. human rights, sharing costs and risks, rights of indigenous community), animal welfare (e.g. good health and welfare) and ecological health.

Corporate sustainability frameworks	
CDP - Water Security	The CDP is a not-for-profit charity established in 2000 to facilitate environmental disclosure. It aims to focus investors, companies, cities and governments to build a sustainable economy by measuring and acting upon their environmental impacts. There are three questionnaires available for companies under the CDP's global disclosure system: climate change, forests and water security.
EU Corporate Sustainability Reporting Reporting Directive (CSRD)	This EU initiative on corporate sustainability reporting requires all large companies and listed companies to disclose risks and opportunities from social and environmental issues, as well as their impacts.
GRI Standards	This commonly used reporting framework provides disclosure requirements for various environmental and social topics including water and biodiversity specific frameworks. It also includes a specific standard for agriculture, aquaculture and livestock.
IFRS International Sustainability Standards Board	The ISSB is developing a framework for sustainability-related risks and opportunity disclosures. It has issued the International Financial Reporting Standards (IFRS) 1 and 2 on general requirements and climate related disclosures in 2023. It is in the process of developing standards for other sustainability topics. ISSB recommends using the Climate Disclosure Standards Board's (CDSB) guidance for water, which remains useful until the ISSB issues guidance on the topic.
Science Based Targets Network (SBTN)	The SBTN provides guidance on setting targets for nature. The process is split into 5 steps 1) assess organizational impacts, 2) interpret and prioritize results, 3) measure, set and disclose targets, 4) act to deliver the targets and 5) track progress. Guidance is available for the first three stages at present. There is also specific guidance for setting SBT for freshwater.
Task Force on Climate-related Financial Disclosures (TCFD)	The TCFD is a market-led initiative launched by the Financial Stability Board (FSB) in 2017. It aims to support stakeholders in assessing risks related to climate change through promoting disclosure of climate impacts and risks.
Taskforce on Nature-related Financial Disclosures (TNFD)	The TNFD is a market-led initiative launched in 2021. The initiative builds upon the related TCFD, aiming to give the same focus for nature and biodiversity. The TNFD Framework ultimately aims to support a shift in global financial flows away from nature-negative outcomes and toward nature-positive outcomes. The TNFD includes metrics of core disclosures as well as sector specific metrics.
TNFD Food & Agriculture Guidance	This draft provides the sector specific core and additional disclosure requirements and guidance for the TNFD, specific to the food and agriculture sector. This guidance will be finalized in 2024.

Water-related resources	
Alliance for Water Stewardship	The alliance provides guidance on how to evaluate water-related risks, commit and plan a water stewardship plan for an organization or site within the context of specific water basins. It also provides guidance on implementation and monitoring and disclosure of progress, including targets to increase water use efficiency and reduce total volumetric water use.
CEO Water Mandate	This initiative run by the UN Global Compact drives corporate progress on water stewardship.
Earth Stat Water Depletion layer	Using WaterGAP3, this dataset provided on the Earthstat platform, provides information on long-term average annual consumed fraction of renewably available water in basins. The data is available globally but only for basins larger than 1,000 km2. It categorizes the basins into 8 water depletion categories.

Four billion people facing severe water scarcity | Science Advances Mekonnen & Hooekstra, 2016	This peer reviewed paper presents data on global blue water scarcity.
Freshwater Accountability Navigator (FAN) - World Business Council for Sustainable Development (WBCSD)	This publicly available guidance helps to direct businesses to various frameworks and tools as relates to assessing water-related impacts and dependencies, setting water targets, taking transformative action and disclosing water-related information. The FAN will help sustainability professionals to identify key frameworks to use depending on their current level of water maturity and data readiness.
GEMStat - The global water quality database	The GEMStat (Global Freshwater Quality Database) provides data on the state and trends in global inland water quality for multiple sampling locations worldwide. It is a part of the water program of the United Nations Environment Program.
Global data on crop nutrient concentration and harvest indices	This global dataset of crop nutrient concentrations and harvest indices is based on analysis that compiled datasets from various reviews in a standardized forms. Indices are available at a global average level or for specific regions (where available).
Setting Enterprise Water Targets: A Guide for Companies (2021)	This guidance on setting enterprise water targets at the local level is informed by assessments of water materiality and risks across the value chain. A toolbox is also available to help with this process
The Green, Blue and Grey water footprints of crops[83]	A UNESCO-IHE report on the green, blue and grey water footprint of different crops and derived products. It provides information on water footprints in m3/ton.
Volumetric Water Benefit Accounting (VWBA)	VWBA empowers companies with a comprehensive, standardized and science-based methodology to calculate and valuate the benefits of water stewardship activities. This new method enables businesses and other key stakeholders to better tackle shared water risks at catchment-scale. See also v2.0: VWBA-2.0-Installments-1-and-2_Interim-Guidance.pdf (blueriskintel.com)
Water Action Hub | 100 Priority Basins	This set of 100 priority basins identified by the Water Action Hub is based on the need due to current water and biodiversity risks and opportunities for water stewardship.
Water Footprint Assessment Manual	This guidance on the assessment of water footprint includes overall water use (incl. water consumption from blue and green water), as well as direct and indirect water use. The guidance is for the overall water footprint of consumers or products throughout their life cycle but includes useful resources on calculating blue and green water footprints, as well as green and blue water evapotranspiration.
Water Quality Benefit Accounting	This forthcoming methodology will serve as a companion guidance to VWBA in calculating water quality benefits associated with water stewardship projects (from WRI and partners)
World Resources Institute (WRI) Aqueduct	This framework provides 13 water risk indicators that cover water quantity, quality and reputational risks and combine these into an overall risk score for water, including information on baseline water stress.
WATERSTAT Water Footprint Statistics	WATERSTAT's range of datasets on the water footprint associated with different products and countries is available through the Water Footprint network. This includes information on the blue and green water footprints of crops, farm and animal products. The resource also includes datasets on blue water scarcity and pollution due to N & P.
WWF Water Risk Filter	The filter is a free and leading tool for helping assess water risks. It includes information on river basins prone to water scarcity, low water quality, as well as regulatory and reputational risks

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About Regen10

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