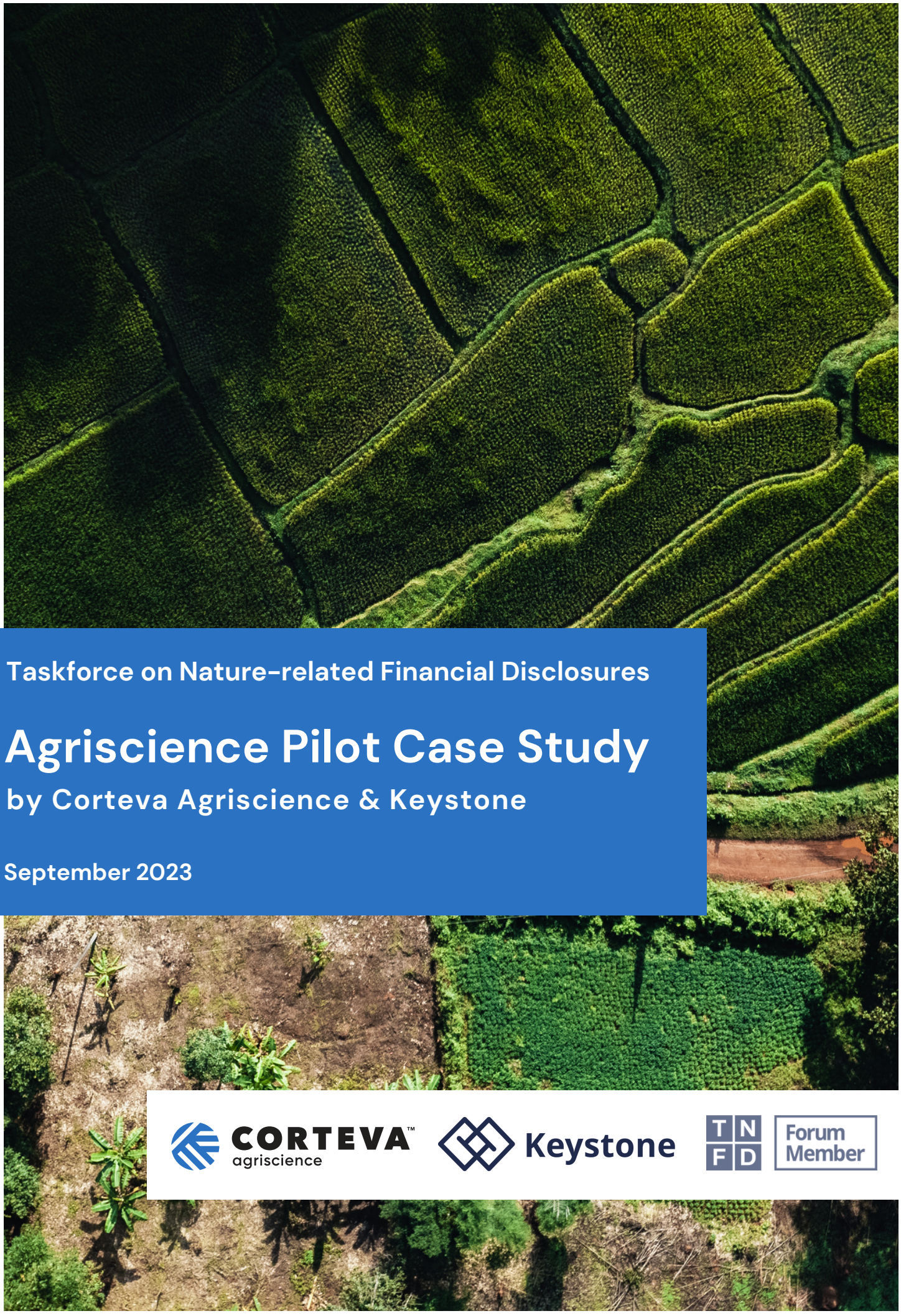

Taskforce on Nature-related Financial Disclosures

Agriscience Pilot Case Study

by Corteva Agriscience & Keystone

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CORTEVA™ agriscience

Keystone

TNFD Forum Member

Introduction

This case study shares how Corteva Agriscience, a U.S.-headquartered agriculture company, conducted a pilot of the Taskforce on Nature-related Financial Disclosures (TNFD) framework to the agriscience sector. This pilot was a partnership between Corteva, a member of the TNFD Forum, and Keystone, a biodiversity software provider and TNFD Data Catalyst. The assessment was done using Keystone's software by integrating Corteva's business data and leveraging a variety of third-party data sources.

This report focuses on the Locate phase, and provides a summary of two issues identified in the Evaluate and addressed in the Assess stage, using TNFD Beta framework 0.4.

The TNFD LEAP framework is a 4-stage process that helps companies:

1. **Locate** their businesses' biodiversity and nature-related footprint, prioritising high-impact sites for further evaluation;
2. **Evaluate** prioritised sites for nature-related impacts and dependencies;
3. **Assess** the nature-related risks and opportunities; and
4. **Prepare** to respond and report on the identified outcomes.

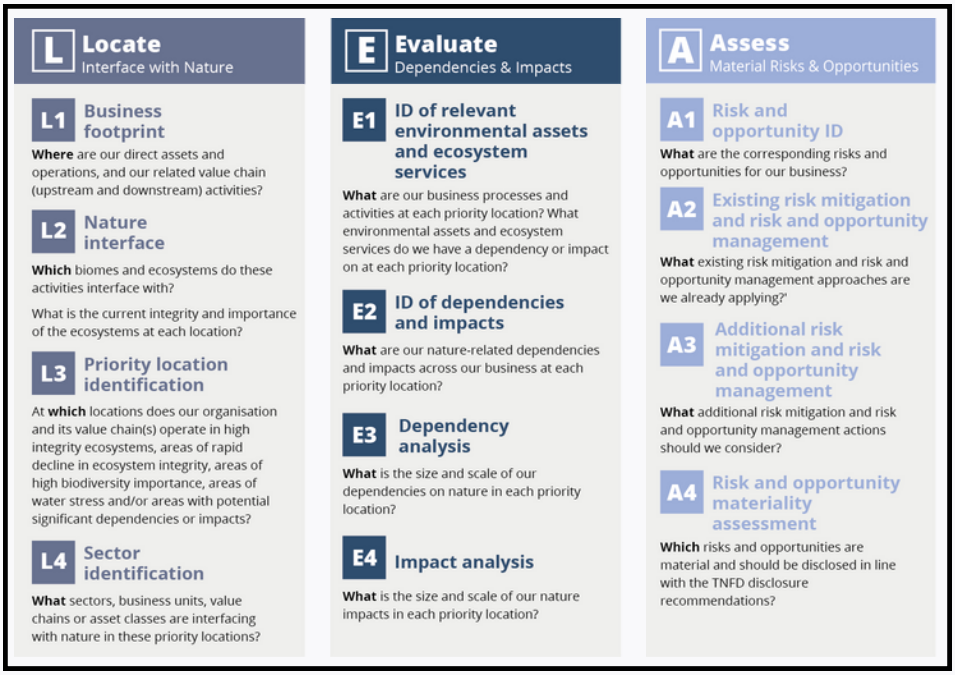

Figure 1: This case study focuses on the Locate phase and provides highlights of two issues in the Evaluate and Assess phases of the TNFD LEAP framework. Image adapted from TNFD guidance

1. Locate: Interface with Nature

L1 - Business Footprint

Corteva's business is structured around two primary segments: providing seeds and crop protection products to farmers globally. Corteva operates in more than 140 countries, with over 85 production and manufacturing facilities and 150 research and development (R&D) facilities.

L4 - Sector Identification

Corteva selected its seed R&D business line for piloting the TNFD framework as the company directly manages its seed R&D centers, providing greater data availability for assessment. This

Figure 2: A Corteva research and development lab with greenhouse

segment was also chosen for its scalability, as pilot insights can be applied to the entire segment using Corteva's standardized data collection processes.

Site Selection

Keystone collaborated with Corteva to select five seed R&D centers for the pilot project. In selecting high priority sites, five R&D research centers identified as utilizing irrigation in initial assessments were chosen to align with Corteva's critical dependency on water for production. To capture regional variations, one facility was chosen from each continent where Corteva operates.

The five chosen R&D centers primarily focus on seed breeding, among other seed research and development processes. Corteva's breeding organization, along with local testing and product advancement practices, ensures that products from the Corteva R&D engine meet growers' needs. Corteva combines locally adapted germplasm with leading traits and crop protection products, offering comprehensive solutions to enhance yield performance for growers. Activities related to sustainable germplasm development include breeding seeds with improved resistance to heat, drought, diseases, pests, and herbicides, along with phenotyping, genotyping, seed development, and yield testing. Each site's operational activities are summarized in Table 1.

Seed R&D Facility Location	Crops of Focus on Site	Main Operations
Europe	Cereal grains, oilseeds	Seed breeding
North America	Cereal grains, oilseeds, legumes	Seed breeding
Asia	Cereal grains, oilseeds	Seed breeding
Africa	Cereal grains, oilseeds, legumes	Seed phenotyping, breeding
South America	Cereal grains, legumes, fiber crops	Seed phenotyping, breeding

Table 1: Pilot site locations and operational activities

All sites have farmland and, or greenhouses in addition to their advanced seed R&D buildings for planting and evaluating seed performance. Corteva has constructed a robust breeding system that leverages genetic, statistical, engineering, and analytical principles, enabling global access to localized seed solutions.

L2 - Nature Interface

After site selection, Keystone analyzed the sites' interaction with nature by identifying the biomes and ecosystem function groups they were located in. The software used multiple state-of-nature Geographic Information System (GIS) layers, such as the UN Biodiversity Lab, and the IUCN Global Ecosystem Typology. The primary ecosystem function groups identified for each site were:

1. **European site:** T3.2 Seasonally dry temperate heath and shrub-lands
2. **North American site :** T7.1 Annual croplands
3. **Asian site:** T1.2 Tropical/Subtropical dry forests and thickets
4. **African site:** T4.5 Temperate sub humid grasslands
5. **South American site:** T1.2 Tropical/Subtropical dry forests and thickets

L3 - Priority Location Identification

To identify high-priority pilot sites for further analysis in the subsequent stages of the LEAP process, Keystone applied TNFD's four scoring criteria (see Figure 3). A site received a high-priority rating if it achieved a high score on any of the four criteria. This section outlines how each of the four criteria was calculated.

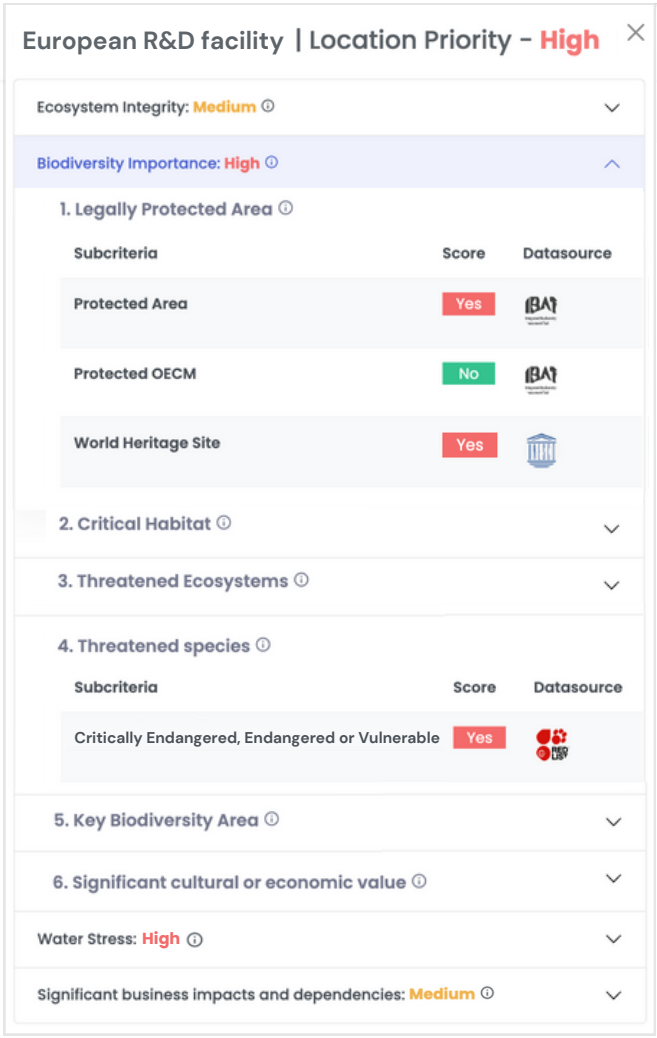

Figure 3: Site prioritisation within Keystone software

Ecosystem Integrity

The L3 Locate criteria require the prioritization of high-integrity ecosystems or areas with a rapid ecosystem decline. Ecosystem integrity at each site was assessed using the Ecosystem Integrity Index (EII), which evaluates the extent of ecosystem degradation across three key elements: ecosystem structure, composition, and function. Sites with high ecosystem integrity receive priority for conservation efforts to prevent further degradation. The EII score for each site was calculated using the methodology in Hill et al., 2022. None of the sites met the criterion for high ecosystem integrity (>0.7) on a scale from 0 to 1, where 0 represents the most degraded ecosystems.

To evaluate ecosystem degradation rates, Keystone analyzed satellite imagery from the past 20 years at each site to assess habitat conversion. No site had significant land conversion from primary or secondary habitat, as all sites were established croplands prior to 2000 and therefore were not sites of rapid decline.

Biodiversity Importance

Biodiversity importance was scored using the six criteria specified in the L3 guidance (see Figure 3) and screened against the IUCN, IBAT, Protected Planet, and World Heritage lists. The European R&D center received a high rating for biodiversity importance due to its proximity to a protected section of a local river, designated as a Natura 2000 site and is a tributary to a part of a Key Biodiversity Area (KBA). Approximately 56% of this KBA is also protected as a national park.

Water Stress

All sites, except the South American site, were found in locations of high water stress when measured using TNFD's methodology. TNFD defines water-stressed locations as areas where the quality and/or quantity of available water are deteriorating. To assess water stress at each site, Keystone cross-referenced data from three public databases: the WWF Water Risk Filter, the WRI Aqueduct, and the SBTN State of Nature Water Layers, ensuring data accuracy.

Significant Business Impact and Dependency

All sites were rated medium in terms of their reliance on their respective environments for operations. This reflects the dual nature of the work: while seed farming activities are dependent on ecosystem services essential for crop growth, the R&D operations conducted indoors have a lower dependency on surrounding environmental assets.

2. Evaluate: Impacts & Dependencies

After filtering to identify prioritized sites for further assessment, Keystone's software conducted a site-specific assessment of nature-related dependencies and impacts on each of the prioritized sites in the Evaluate phase.

E1 - ID of Relevant Environmental Assets and Ecosystem Services

Environmental assets and ecosystem services crucial to crop farming on Corteva's sites were identified using the United Nations' System of Environmental-Economic Accounting, guided by ENCORE's materiality ratings. The results were then tailored to each site's ecosystem characteristics. Figure 4 displays the top ecosystem services and assets on which Corteva's farming operations depend.

Ecosystem service	Materiality	Production process relationship	Reason	Environmental Assets
Genetic material	VH	Direct physical input	• High genetic quality and diversity of seeds is critical to seed research, development.	• Land • Cultivated biological resources
Water supply	VH	Direct physical input	• High volumes of water are required for multi-crop seed germination and crop establishment.	• Freshwater ecosystems • Subterranean freshwater ecosystems
Soil quality regulation	H	Enables production process	• Soil fertility is critical for crop establishment and testing the performance of seeds.	• Atmospheric systems • Land • Subterranean terrestrial ecosystems • Minerals • Water resources

Figure 4: Top three ecosystem services and environmental assets identified for the pilot sites

Figure 5: Corteva researchers undertaking geospatial observations using a drone

E2, E3 - ID of Dependencies and Impacts & Impact Analysis

Keystone assessed potential impact drivers for each of the five locations. This section summarizes the assessment of two of the highest-impact drivers: water use and proximity to protected areas.

High freshwater withdrawal rates from water-stressed areas

Water use was consistently identified as the primary impact driver on nature for four out of five sites due to farming irrigation, which consumes a significant amount of water.

Keystone's software analyzed water usage data along with satellite imagery, land registry records, water information, geological surveys, and nature datasets to identify each site's water source and effect on freshwater basins. The sites selected for the study within North America, Asia, and Europe were the most impacted by Corteva's water withdrawal rates.

Given Corteva is a commercial water consumer at all five sites, it is required to, and complies with local water use and environmental regulatory standards and obligations at all of its R&D facilities. In order to meet or exceed such requirements, Corteva monitors the withdrawn water's quality at all sites to ensure it meets the necessary standards for its intended use and to prevent potential contamination of its systems. Water discharge volumes are closely monitored based on their destination to comply with local discharge regulations and effectively manage the impact on their respective water bodies.

For example, for the European R&D facility, since the protected river nearby serves as the primary water source for both Corteva's research center and the surrounding experimental fields, water extraction is carefully regulated. Corteva is part of a regional irrigation community, where water is captured from the river and stored in community-owned rafts. From there, it's distributed through buried pipes to various agricultural operations in the area, typically using a drip system. Water allocation fluctuates each agricultural season based on factors like rainfall

and existing water reserves. To ensure responsible usage, individual farms are equipped with water meters, and water supply is halted once the allocated amount is reached.

Proximity to protected areas and areas of high conservation value

As identified in the Locate L3 stage, Corteva's European site is close to a protected section of a nearby river. Further assessment of the biodiversity in this river is revealed that it is potentially important for at least 13 species classified as threatened by the IUCN Red List of Threatened Species.

This river also serves as a vital tributary to the highly biodiverse marsh, part of which is protected as a national park that serves as habitat for at least 12 endangered plant and vertebrate species, of which two are endemic.

E4 - Dependency Analysis

The most significant dependency issue identified for Corteva's pilot sites was freshwater access. Four out of five sites were found to pose a high impact to Corteva's operations according to the TNFD analysis framework due to their long-term reliance on high-quality freshwater. This reliance on freshwater quantity and quality is crucial for Corteva's product stability and effectiveness, and a lack of quality water could compromise product quality, potentially resulting in product failures.

3. Assess Risks & Opportunities

Keystone compared the key impacts and dependencies found at the five sites against Corteva's existing sustainability management program to identify potential gaps and opportunities for mitigation.

A1 - A2: Potential risk & opportunity ID, existing risk & opportunity management

Corteva already maintains robust environmental sustainability policies to comply with local and state regulations. These policies address various areas, including water use, waste management, emissions, and scientific testing of product impact on potentially affected species.

Corteva recognizes that a portion of its environmental impact stems from downstream product use. In response, it has developed innovative seeds with a lower environmental footprint than industry standards. These include high-productivity seeds that use water more efficiently and pest-resistant seeds that are safer for non-target organisms.

Freshwater usage

In addition to the water management measures identified in the Evaluate phase that Corteva implements to meet or exceed local regulations, the company also implements additional water stewardship measures at all of the sites.

These measures encompass water-efficient techniques, including advanced irrigation methods, to reduce water consumption. Corteva also maintains regular water metrics reporting, with detailed monitoring of facilities using over 100,000 gallons of water annually. Additionally, Corteva monitors water discharge volume and its intended destination, allowing for the assessment and management of potential effects on receiving water bodies, thereby minimizing the potential for adverse impacts and promoting responsible water management practices.

Figure 6: A Corteva researcher conducting observations within its R&D croplands

At the community level, Corteva actively engages in local water stewardship programs and ongoing monitoring to minimize its impact on freshwater basins. Particularly in the North America, Asia, and Europe, where our water withdrawal rates are potentially more impactful, Corteva collaborates with local authorities and communities to ensure sustainable water use.

Proximity to protected areas and areas of high conservation value

Each of the five R&D facilities have had sustainable agricultural practices and ecosystem protection programs in place for decades on its croplands. These initiatives span from restoring native plant species and implementing sustainable water management systems to establishing pollinator protection programs. These programs are put in place for performance against Corteva's long-term commitments to enhance and preserve local ecosystem health and biodiversity.

In the case of the European R&D center, Corteva's involvement in the local irrigation community ensures sustainable management of water withdrawal rates at the basin level. Local authorities closely monitor the impact of water use on the surrounding protected areas and key biodiversity zones to ensure that the water allocations provided to Corteva and other participants in the irrigation community enable the preservation of these ecosystems. This basin-level management approach fosters holistic water use management as a collective as opposed to fragmented water management programs by each standalone consumer.

4. Prepare to Respond & Report

By being one of the first agriscience companies to test the TNFD framework in its direct operations and sharing insights gained in this case study, Corteva reaffirms its commitment to promoting a nature positive impact within the agriscience industry. The learnings from the TNFD pilot will help to inform the next steps in Corteva's sustainability journey, including future nature related impact assessments.

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