

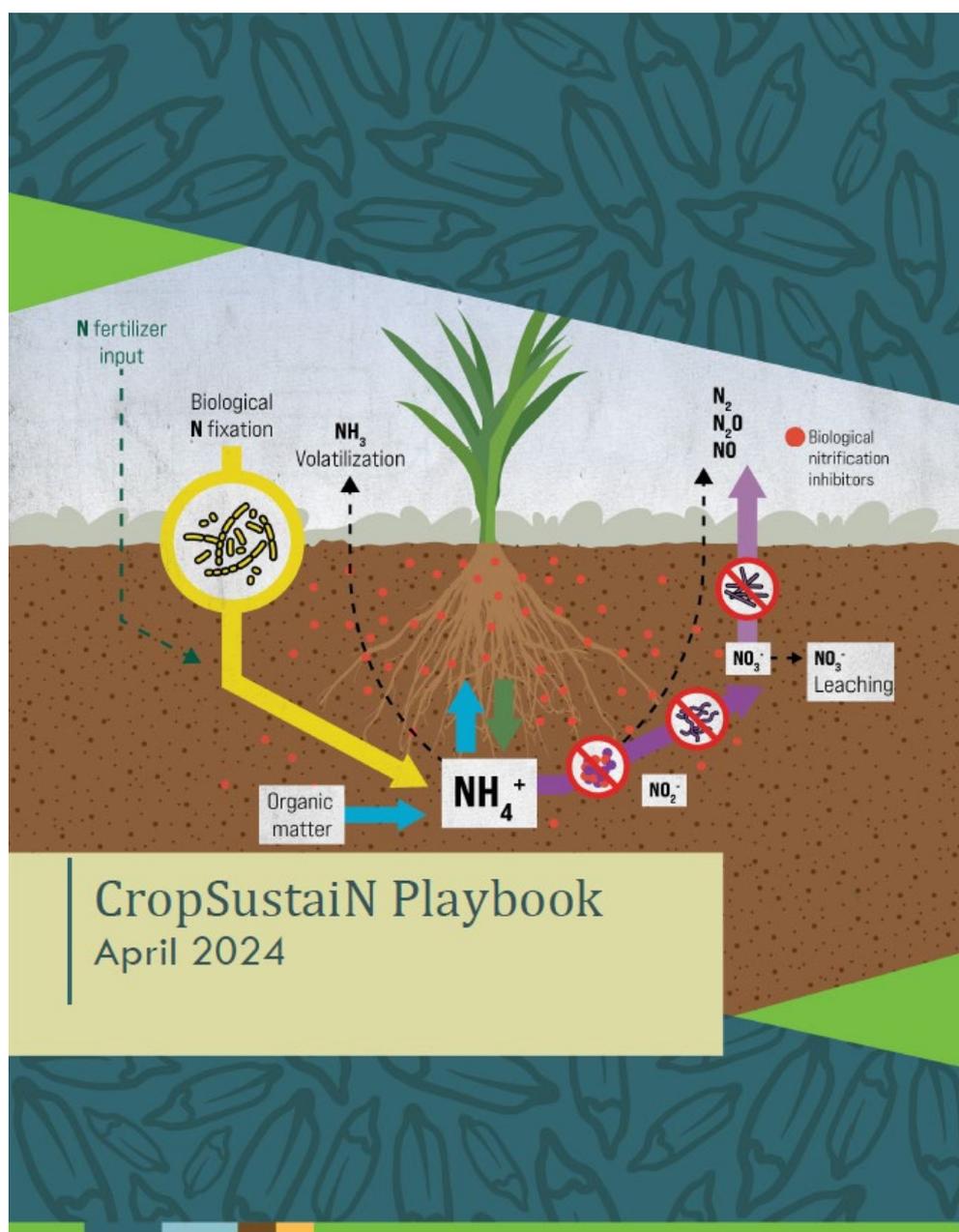
Annual Technical Report 2024

Project title: CropSustainN: A new paradigm to reduce the nitrogen footprint from agriculture.

NNF No. [NNF24SA0092547](#)

Reporting Period: 01 July 2024 – 31 December 2024, 1st half year of CropSustainN YRI, which ends 30 June 2025.

Key results, achievements or learnings highlighted in bold blue.



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1. SET UP

1.1. Acknowledgements

- CIMMYT and its CropSustain partners greatly appreciate Novo Nordisk Foundation's mission funding and high risk/high reward approach, as well as the commitment by the Foundation for Food and Agriculture Research (FFAR) to co-fund (final decision outstanding by January 2025).

1.2. Acronyms / Glossary (see Annex)

1.3. Geographic scope¹

1.3.1. During YR1 to end June 2025, spring wheat research station BNI elite lines field trials ('yield+') in Mexico (3 locations) representative of several major wheat-growing environments, India (3 locations), representative of major Indo-Ganges Plain wheat-growing agro-ecologies, Pakistan and Nepal (trials started; see 1.9.2), Australia (intergrain in-kind partner). Winter wheat: CIMMYT and research partners started on crossing BNI trait into elite winter wheat for European (CH, D, DK, F, UK). For N losses assessment research, research stations in Mexico, with global scope in terms of experimental design and modelling, see 1.3.3.

1.3.1.1. *Managed overlaps with NNF-funded research projects BREED-BNI, BioNI, CEO Grants led by Aarhus and CIMMYT*: Coordinated crossing/breeding & field research activities in Denmark (Sejet), with implications for Scandinavian wheat growing areas; high throughput microbiology platform shared standards and data analysis with global scope, see 1.3.2

1.3.1.2. *'Aligned' projects (e.g. with Give/Take Linkages), such as SATREPS Japan-India bilateral*: Coordinated crossing/breeding & field research activities in India (IIWBR, BISA, IARI), with implications for wheat growing areas in Bangladesh and Pakistan. Discussions about expanding CropSustain geographic reach via aligned projects were initiated in Dec.'24.

1.3.2. *Lab-based research* on nitrifier identification, inhibition pathways and biogeochemical analysis of active BNI root exudate compound have global scope.

1.3.3. *N losses research*: In process of setting up comprehensive research platform in Mexico by end of YR1, building on Aarhus-led CEO Grant 'Field-scale N losses'.

1.4. Overview of actors involved; program partners and stakeholders (who)

1.4.1. For the rolling list of all types of partners, please see here: [BNI Partners post-Playbook updated.xlsx](#); stakeholder tracking is documented here: [Stakeholder Mapping for BNI mission.xlsx](#).

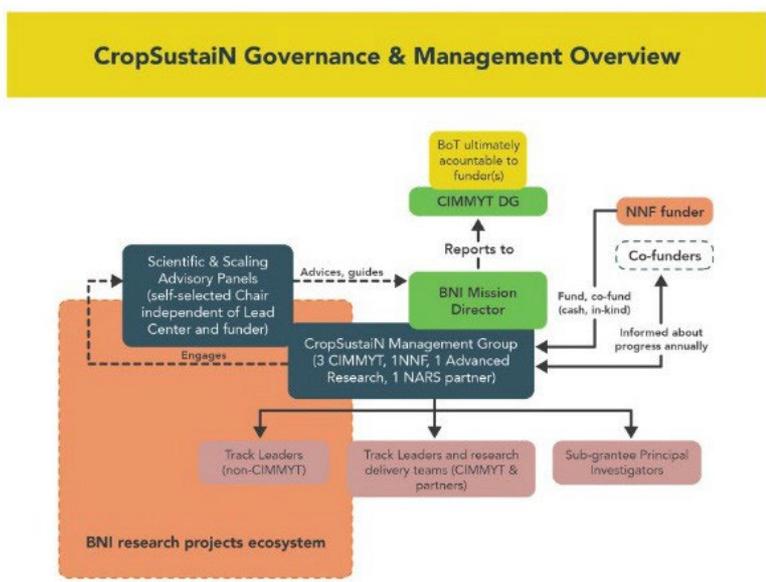
¹ To be visualized on a map in future: Research stations representative of wheat growing areas/mega-environments across the globe.

- 1.4.2. *Sub-grantees - (# in process, # signed)* – see list under 1.4.1. [Of the anticipated 20 sub-grantees, 3 have signed the agreement by December 2024.](#) Whilst CropSustain is delayed in completing sub-grant agreements (SGA), on-time partner delivery within YR1 has not negatively affected so far.
- 1.4.2.1. *Sub-grant agreements (on what):* Key research areas covered by sub-grant agreements (SGA) for YR1 are: Elite BNI lines performance / yield trials in up to 10 countries, N losses assessment using isotopes to track N flow (U New Hampshire), align and incorporate BioNI partners (Tracks 3 & 6), crossing BNI into winter wheat (JKI, INRAe/Arvalis, JIC; other partners are in-kind).
- 1.4.3. *In-kind research partners* – See list under 1.4.1. In-kind partners will all sign a Research Agreement. Some sub-grantees (will) provide in-kind support. Major in-kind research partners include intergrain (Australia; 50 multi-location testing sites) and Canadian partners (multi-location testing, breeding into winter wheat, sequencing and marker development).
- 1.4.4. *Aligned project partners (Give and Take Linkages established in writing).* CropSustain initiated discussion with potential aligned partners during the JIRCAS-convened BNI Consortium meeting in Dec. 2024. The target is to agree 5-10 such partnerships during YR1.
- 1.4.5. *Collaboration guidance (how) documented in this folder: [01 Collaboration Consortia Rules Practices.](#)*
- 1.4.5.1. By 1Q 2025, in-kind Project Participants (e.g. intergrain-AU, PPG Seeds-NZ, Agroscope-CH) will have signed a Research Agreement (RA), with all guidance included, including joint publications. Aligned partners will sign an agreement at project leader level that documents Give and Take Linkages.
- 1.4.5.2. Sub-grantees sign a sub-grant agreement (SGA) and receive additional, complementary Collaborations Guidance, identical to RA content, but for a reminder that sub-grantees must abide by the General Terms and Conditions and CIMMYT/NNF policies ‘flow down.’
- 1.5. *BNI Mission approach*
- 1.5.1. Aiming for societal impact requires taking a systems approach (Genetics x Environment x Management x Policy). A limited problem space helps to manage systems complexity and determine practicable pathways for innovation. This mission builds on strong interest from public and private sectors: scientists, breeders, farmers, seed businesses, extension agents, and climate change and agriculture policymakers – all being important actors in the innovation systems that allow the possibility for BNI-wheat scaling in different contexts. CropSustain will leverage the “adjacent possible” by building on the potential around existing knowledge and technology, rather than seeking radical breakthroughs (see [Playbook, p.5-6](#)). -



1.6. Research program management and governance:

- 1.6.1. **Management Group (MG) - is established & operational.** Advanced Research and National Agricultural Research System partners are represented by Simon Griffiths (John Innes Center) and Dr. Tiwari (ICAR-IIWBR) respectively. It has met three times, the December '24 meeting was moved to mid-January '25. -MG has approved the Management and Governance Handbook, endorsed Collaboration Guidance (see 1.4.2 above), guided the CropSustain Mission Director on membership and ToRs of the Scientific Advisory Panel , sub-granting budgeting and consultancies, as well as reviewed progress on attracting co-funders.
- 1.6.2. **Governance: Scientific and Scaling & Markets Advisory Panels (SAP; SMAP) –** the SAP is operational, selected its Chair, provided guidance on a comprehensive approach to N losses and set the next meeting/key agenda items (March 2025) – see ToRs in Management and Governance Handbook. Meeting minutes are accessible to all project participants. The SMAP will be set up by 2nd or 3rd quarter 2025.



1.7. Impact pathway rationale

- 1.7.1. *Theory of change (ToC)* – see p.60 in Playbook. The ToC describes ‘what and how much science is needed to convincingly establish BNI global potential, why and how farmers are likely to innovate and grow BNI wheat & enabling conditions from a market/value chain and environmental / climate change mitigation policy perspective. Using the ToC, CropSustainN will generate learnings about interdisciplinary practices, complementarities and trade-offs, as well as about adoption and scaling dynamics and drivers.
- 1.7.2. *Impact data model (IDM)* – tracks measurable progress from outputs to outcomes. It is the basis for [the scorecard that CropSustainN has developed](#), which is linked to TEAMWORKS project management (e.g. evidencing progress). The scorecard documents progress towards outputs and outcomes and respective verification, or evidencing (e.g. experimental design, protocol, development of BNI elite lines, N losses research data, etc.). The scorecard will be updated annually.

1.8. Implementing the Research Strategy

- 1.8.1. *Research Tracks, their scope, interdependencies* – CropSustainN research scope, as described in the Playbook ([see pp.20ff](#)), has been translated into a [YR1 work plans across all Research Tracks](#) and a [high level 4-year work plan](#) covering research, partnering, communications and program management. The Mission Director manages Research Tracks implementation and linkages with Track Leads (TL)-Monthly Meetings and rolling minutes, based on Track Leads Roles and Responsibilities description in the [Governance and Management Handbook](#). The Mission Director escalates science issues to-MG, if needed.

CropSustainN Research Tracks

Track 1. Establish and refine a [common framework](#) that harmonizes methodologies

Track 2. Evaluate BNI trait agronomic effectiveness and stability and [transfer translocations to new elite lines](#)

Track 3. Perform field-based assessment of [BNI environmental impacts](#)

Track 4. Explore the feasibility of incorporating BNI activity into [winter wheat](#)

Track 5. Develop [molecular markers](#) associated with Leymus BNI activity

Track 6. Investigate [biochemical mechanisms](#) of BNI activity with microbial ecology

Track 7. Investigate innovation ecosystems and [scaling for impact co-creation](#)

- 1.8.2. A [significant addition to scope](#) has been to add 15N/isotope tracking of organic and inorganic N flows to Track 3 research. CropSustainN took this decision, taking on as project partner one of the Playbook scientific reviewers, [responding to SAP concerns](#) about N losses research scope.

1.9. *Baseline*²

- 1.9.1. *CropSustain* - with BioNi's contributions, established a foundational baseline comprising two BNI sources and six spring BNI Elite lines, providing a critical starting point for the initiative. For detailed baseline items, refer to the scorecard provided in [Annex 4.4](#). A peer-reviewed publication is planned for 2025 to deepen on this baseline explanation and be understood in scientific terms.
- 1.9.2. *CEO-Grant BNI-wheat Future (NNF22SA0082129)*– Research under this grant started in May 2023 and contributed these [baselines for CropSustain](#): Newly developed BNI elite spring wheat lines, research field experimental design and protocols for Mexico, India Pakistan, Nepal, Ethiopia and Kenya locations, implementing field research and first set of results. Research under this grant ends 30 April 2026 and will by that time be fully integrated into CropSustain Track 1 and 2.
- 1.9.3. [Field-scale nitrogen losses from BNI wheat \(Aarhus-led\)](#) - Research under this grant started in January 2024 and enabled an early start in designing and validating comprehensive N losses assessment on research stations, by bringing in Aarhus University expertise. This is a baseline contribution to the Common Framework and setting up N Losses assessments in India and Kenya. The learning generated by research under this grant will be fully integrated into Tracks 1, 3 and 6 by April 2026, when this grant ends.
- 1.9.4. *BioNi (BNI: a novel high-throughput platform integrating wheat genetics, natural product chemistry and microbial ecology approaches - NNF22SA0078638)*: BioNI research started in 2023, a good year before CropSustain kicked off. All BioNI science partners are also CropSustain partners. In 2024, BioNI contributed two publications, two methods and tools (eg. high-throughput microbiology platform) and collaboration & partnerships (eg. access CIMMYT-JIRCAS lines) to CropSustain's baseline.

2. PROGRESS

- 2.1. *Executive summary*³: By end of December 2024, the 4-year work plan and annual 2024 work plan to establish the global potential of BNI wheat have been agreed with all YR1 implementing partners. Research management and governance is operational and YR1 partnerships have been mutually agreed, with sub-grantee flow of funds initiated. Via the Research Track leaders and participatory design of the Common Framework, linkages to ongoing BioNI and CEO Grants research have been assured. Development and refinement of methodologies (see 1.8.2.), experimental designs and protocols, as well as

² Baseline in terms of partners, germplasm, N losses and soil sciences, innovation systems, farmer behavior; research product, methods and tools, hypotheses.

³ Summarize outputs, results of ongoing activities incl. methodological breakthroughs, learning. Describe major constraints to implementation, unexpected side-effects; point to use of results by other scientists, projects and beneficiaries, user/learning feedback. If outputs could not be achieved, state why. Credit use/learning from 'aligned' projects.

breeding research (e.g. develop new BNI spring and winter wheat lines) has started, with [some initial outputs \(e.g. fingerprinting marker; research seed multiplication & distribution\)](#). Data management infrastructure and practices have been agreed and implementation is ongoing (see 1.4.4).

- 2.1.1. The science (see 1.9.1 & 2.1) Playbook reviewer and SAP guidance [led to a budget shift towards Track 3](#) and expansion of below-ground research scope. [Planning took place to expand winter wheat scope in 2025](#), based on anticipated co-funding. The interdisciplinary approach to experimental design [led to significant learning](#) (e.g. incorporate modeling perspective from the start). CropSustain-MG **reviewed the draft Common Framework** on 17th Jan 2025. It documents how the Research Tracks interact in terms of common researchable issues, hypotheses and methodologies; and an overview of all measurements and how they interlink to build the case for global potential.
- 2.1.2. Partners: Sub-grantee onboarding started early but is delayed (see 1.4.1). CropSustain has [attracted additional in-kind partners](#) (e.g. Agroscope) and is [negotiating with in-kind partners to expand their scope](#) (e.g. take on N losses research). Track 5 is convening aligned partners (e.g. Genome Canada-funded U. Saskatchewan) on sequencing and marker development work.
 - 2.1.2.1. Partner interest/motivation: It is noteworthy that [some seed companies consider the major CropSustain 'win' to be a leap jump in nitrogen use efficiency](#). Wheat, and cereals nitrogen use efficiency has hardly changed since the 1990's.
- 2.2. *CropSustain* has attracted and is engaging with [in-kind and aligned partners](#), whilst raising awareness about BNI and BNI-wheat's climate change mitigation potential with the wider research community (see 2.3 below) and some donors (e.g. discussions with FFAR, GRDC, Sasakawa and others, see [co-funder engagement tracking](#)).
- 2.2.1. Tracking of R-to-D progress of alternative, complementary mitigation-in-Agriculture approaches is under development, to be reviewed by CropSustain-MG and -SAP by end 1Q 2025.
- 2.2.2. Program Management, business support, co-funding: NNF-CIMMYT collaborative co-funding strategy agreed. [FFAR \(USA\) requested a formal proposal for \\$2M co-funding](#) for US-focused winter wheat and improving capacities for N losses research. Final approval is expected in January 2025.
- 2.3. *Impact pathway and workplan:*
 - 2.3.1. *milestones to outputs* - progress is on track according to the YR1 work plan, accessible through Teamworks. Milestones have been defined annually starting from 01 July 2024. As CropSustain has been underway for six months, it is currently premature to provide a coherent summary of milestones reached for outputs achieved.
 - 2.3.1.1. *% achieved (e.g. 3/5 keep it simple)* - nothing to report

2.3.1.1. *outputs to outcomes* - not applicable for this reporting period

2.4. *Knowledge management*, -sharing (e.g. publications, presentations) and Communications (e.g. media work, events):

2.4.1. *Communicating progress*:

2.4.1.1. *Brief description of press, social media and other communications work* <https://www.cimmyt.org/tag/bni/> & *press releases, blogs and similar*. Communications is integral to the 4-year and annual planning. During 2024, communications actions focused on NNF Board approval of the CropSustain Playbook, the International Wheat Congress 2024 and the BNIConsortium Meeting.

2.4.1.2. *For ongoing tracking of publications with CIMMYT co-authors, see here:* <https://repository.cimmyt.org/search?query=BNI%20>

2.4.2. *Engagements*

2.4.2.1. *BNI wheat workshop at Tropentag 2024 (September, Vienna.)* <https://www.tropentag.de/conference/workshops.php> see *WS22* was organized by the University of Vienna, a BNI Consortium member. Key aims were to connect CropSustain to all Vienna-based BNI scientists and raise awareness about BNI with early career scientists working in international research for development (IAR4D).



Tropentag 2024

13.09.2024 | Vienna, Austria

Workshop 22: Plants, Microbes, People & Learning Landscapes: Biological nitrification inhibition (BNI) for Sustainable Agriculture
Contact: wolfram.weckwerth@univie.ac.at
Date: Friday, 13/09/2024, 14:30 – 16:30 h (CEST)
In-person workshop
Location: S/WA SR26
14:15 - 14:30 Arrival and Welcome
14:30 - 14:45 Welcome talk by Wolfram Weckwerth - Introduction, overview to the BNI research at UNIVIE and VMC 10 min talks. Keep 5 minutes for Q&A/discussion.
14:45 - 15:00 Talk: Victor Kuznetsov, BNI mission Director, CIMMYT, CGIAR: Why a BNI wheat mission/initiative now? What is a mission? Impact pathways. Set stage.
15:00 - 15:15 Talk: Christa Schaefer, UNIVIE: Ar/hya biology, ammonia oxidation, soil microbiology
15:15 - 15:30 Talk: Arindam Ghosal, UNIVIE: Root exudate sampling, metabolomics, technical details
15:30 - 15:45 Coffee break and individual discussions

2.4.2.2. *BNI wheat workshop & engagement of potential research partners and co-funders at International Wheat Congress (September, Perth.)* <https://www.iwc2024.com/wp-content/uploads/2024/09/WS-16-Biological-Nitrification-Inhibition-BNI-22-September.pdf>: At this conference, CropSustain attracted new in-kind partners (Agroscope, CH), engaged with existing ones (intergrain, PGG Seeds) and engaged with potential Australian research partners (CSIRO, UQueensland, UMurdoch and funders (GRDC).



BNI wheat workshop at International Wheat Congress



CIMMYT and USAID visit JIRCAS HQ with BNI wheat lines exhibited in entrance hall



2.4.2.3. *CropSustain Give and Take Linkages workshop at BNI Consortium Meeting convened by JIRCAS (December, Tsukuba, Japan)* - On 7th December, CropSustainN interacted with 60+ participants of the BNI Consortium Meeting convened by JIRCAS, to communicate the concept of Give and Take Linkages and spell out such linkages in parallel small group sessions. The aim is to establish 5-10 Give/Take Linkages with other BNI research projects during CropSustainN's lifetime. Discussions started with 3 projects.



- 2.4.3. *capacity development* - nothing to report
- 2.5. *Risk management and scope* (see Risk Register: [Risk Register for BNI mission NNF Template.xlsx](#)) – in this section, we focus on high priority risks (in red).
- 2.5.1. Risks associated with mission set-up and program management and governance
- 2.5.1.1. The key risk (#7) of not convincing the NNF Board was avoided. NNF and CIMMYT consensus on delivering international public goods and open access knowledge is strong (#3). The NNF-internal stage-gating process took one quarter longer than planned.
- 2.5.2. Risks associated with delivering the science / research
- 2.5.2.1. So far, the trait has been successfully and stably introgressed into elite lines (risk #29). CropSustain will continuously check the stability of trait expression. It is too early to assess risks related to CropSustain's outcomes-to-impact phase (#23, #25, #30).
- 2.5.3. Risks associated with partnering and partnerships
- 2.5.3.1. Operating in Ethiopia has become very difficult. CropSustain is developing a work-around.
- 2.5.3.2. CIMMYT reached out to key potential science delivery partners (subgrantees) early. The BNI Mission Director decided to build partnerships linked to ongoing or emerging relevant NNF grants (e.g. BioNI, BNI-BREED, SMARTFIELDS). Gaining an overview of the global BNI research projects ecosystem and engagement of potential research partners at different levels of intensity started early. BNI-related research has picked up globally in the last 2-3 years. Overall, partner interest has been high (see risks #10, #13). Bringing partners onboard (e.g. subgranting process) is taking one to two quarters longer than planned, without any risk to delayed delivery as per YR1 work plan (see risk #14), including sharing research germplasm with partners (#17).
- 2.5.4. Risks associated with alternative mitigation pathways
- 2.5.4.1. None identified. The CropSustain Mission Director has proposed a tracking approach that has not yet been reviewed by the Scientific Advisory Panel. With regard to biological nitrogen fixation (BNF), a [2024 paper by Ken Giller et. al.](#) contends “that regulations are

required to prevent the sale of inoculant products with unsubstantiated and spurious claims of stimulating N₂-fixation by inoculating with bacteria.” Though synthetic nitrification inhibitors (SNI’s) have been used by farmers for over 3 decades, their mode of action is still not fully understood (see [2024 paper Rojas-Pinzon et. al.](#)).

2.6. *Efficiency* – nothing to report

2.6.1. Science and research operations – nothing to report

2.6.2. Program and project management and business support – nothing to report

2.7. *Lessons learned*

2.7.1. Stakeholders, reviewers and research partners confirmed the need to start early on market research with farmers and value chain partners (e.g. as planned in Research Track 7). CropSustain may have to broaden the scope and invest more in farmer adoption dynamics research.

3. OUTLOOK

3.1. *Future directions / conclusions for the next reporting period*⁴

3.1.1. This 1st annual technical narrative report covers the first half-year of the CropSustain initiative. During the remainder of CropSustain YR1, the management team expects to onboard more partners at the different levels, expand winter wheat research scope, refine the Common Framework (Track 1) and deliver all planned outputs by end of June 2025, when YR1 ends.

3.1.1.1. Greater and deeper engagement of the global BNI research projects ecosystem remains critical to realizing the mission approach, because this offers opportunities for progressing faster and more comprehensively with the limited resources available to CropSustain.

3.1.1.2. Just as important is to generate greater awareness of BNI research its potential with scientific communities, policy-maker and wheat value chain actors, especially once significant research progress to establish global potential can be shared. It is safe to say that BNI is less well known than BNF (biological nitrification fixation), for example.

3.2. *Other conclusions* – none to report

⁴ State the extent to which outputs are still relevant and achievable, point out issues which require adjustments to the work plan including comments from in-house peer reviews and/or validation of progress by peers. Draw conclusions for the further implementation of the project.

4. ANNEX

- 4.1. Glossary
- 4.2. Staff
- 4.3. Sub Grant Agreements (SGA)
- 4.4. Scorecard: Approach to evidence tracking from outputs to outcomes
- 4.5. ResearchFish Automatic Report
- 4.6. CropSustain Digital Performance Report

4.1. Glossary: Definitions for key terms used in this Annual (Narrative) Report:

Key Terms	Definition
ARI	Advanced research institutes such as public and private universities, Labs, consortia, which focus on frontier, fundamental, deep science, which requires some form of adaptation and translation ('applied research') to turn into useable outputs, services or innovations. CGIAR Centers like CIMMYT provide such applied research in partnerships with ARI's.
NARS	National Agricultural Research Systems, which include national agricultural research institutes (NARIs), universities, non-governmental organizations (NGOs), the private sector, extension agencies attached to research groups, farmer cooperatives and other configurations of farmers involved in the consultative and research processes. The degree and quality of cooperation among such systems varies greatly. NARS exist in Global South and North.
Research Tracks	Structured components of the CropSustain initiative, encompassing discovery research, breeding, field trials, and impact assessment, aimed at enabling the adoption of Biological Nitrification Inhibition (BNI) technologies. These include: <ol style="list-style-type: none"> 1. Establish and Refine a Common Framework for Measurement and Documentation 2. Developing elite wheat lines with stable and effective BNI traits. 3. Field-Based Assessments comparing nitrogen loss potential between BNI and Non-BNI wheat 4. Incorporate BNI Activity into Winter Wheat 5. Creating marker-assisted techniques to support breeding and agronomic efforts in Tracks 1-4. 6. Conducting discovery research to understand BNI processes and associated risk scenarios. 7. Analyze Markets and Enabling Conditions such as demand dynamics, value-chain impacts, and opportunities for market integration.
Partners	Referred to as program partners, CropSustain partners, research partners, and value-chain partners, they are entities collaborating with CropSustain in two modalities funded and/or in-kind. These partners contribute expertise, resources, and knowledge-sharing capabilities.
Stakeholders	Primary beneficiaries such as farmers and their value-chain partners, organizations or individuals participating in research collaborations, aligned projects, or implementation of CropSustain objectives.
Actors	Individuals or organizations actively or potentially involved in advancing the objectives of the CropSustain mission.
Sub-grantees	Organizations or individuals receiving funds under CropSustain to execute specific needs of the program and referred to as: <ul style="list-style-type: none"> - The recipient of Subgrant Funds named in the Agreement (and, to the extent of any permitted subcontract, parties acting on its behalf).
Sub-grant agreements (SGA)	Formal agreements linked to payments to partners, detailing the responsibilities and deliverables of sub-grantees within the CropSustain framework and overall work plan. The SGA is also used to 'flow down' NNF, CGIAR and CIMMYT policies, procedures and practices.
Research agreement	A formal agreement among in-kind partners (e.g. no transfer of funds) outlining the responsibilities, deliverables, and intellectual property terms of research collaborations within CropSustain. These agreements ensure alignment with open-access principles, facilitate sharing of methods and data, and govern co-development efforts between partners.
Aligned project collaboration	Definition and implementation of Give and Take Linkages between CropSustain and independently funded and run research projects that are willing to share or exchange knowledge, know and tools, amplifying impact by leveraging shared resources.

Give / Take Linkages	Collaborative exchanges of expertise and data between CropSustain and external initiatives to achieve mutual goals.
Collaboration guidance	A framework providing structured guidelines for interactions among CropSustain partners. It includes protocols for data sharing, germplasm exchange, publication practices, and conflict resolution, ensuring transparency and trust across the collaborative network.
Management group (MG)	NNF, CIMMYT and NARS and ARI partner members advise the Mission Director on cross-cutting/Tracks research management matters. See Management and Governance Handbook.
Mission Director	Leader responsible for delivering outputs and outcomes, via CIMMYT-internal, CropSustain partnerships and beyond. Reports to CIMMYT DG and CIMMYT GWP Program Director.
Scientific and Scaling Advisory Panels	Advisory panels providing expertise on research strategies, technological development, and market scaling.
High risk- high reward approach	A methodology embracing innovative and uncertain strategies to drive significant scientific and societal advancements.
Geographic Scope	Regions targeted by CropSustain, encompassing both the Global South and North, to maximize adoption and impact of BNI technologies.
Innovation Systems	Collaborative frameworks integrating research, development, and market adoption processes to promote BNI technologies.
Impact pathway	The complex sequence of activities, outputs, and outcomes leading to the achievement of CropSustain's goals in the form of eventual impacts over time and space.
Theory of Change	A conceptual model outlining through underlying assumptions how and why desired changes are expected to occur through CropSustain's interventions, i.e. work plans with milestones and result based management approaches.
Impact Data Model (IDM)	A structured framework for collecting, analyzing, and reporting data to evaluate CropSustain's progress from activities and outputs towards expected outcomes.
Work Plan	A detailed roadmap of outputs, timelines, and milestones designed to guide the implementation of CropSustain's objectives. Please see Teamwork.
Milestones to outputs	Key interim achievements indicating progress toward defined project deliverables contributing to expected outputs.
Outputs to outcomes	The process of translating project results into tangible benefits for stakeholders and the environment. I.e. activity deliverables contributing to outputs with which knowledge generation leads to innovation co-development, acknowledgement, use and further dissemination or uptake. This happens first within CropSustain and partners, then with stakeholders along impact pathways and theories of change.
Market research	Studies assessing demand, feasibility, and scaling potential for BNI-enabled wheat and other crops.
Farmer adoption dynamic research	Research exploring behavioral, economic, and cultural factors influencing farmers' acceptance and use of BNI technologies.
Teamwork	A project management tool signaling progress achieved percentages. In terms of milestones for outputs and outcomes it follows up on tasks assigned to staff while being accomplished. A Gantt chart exists to visualise work plan activities and connections between activities and results.

Scientific Terms	Definition
Spring Wheat	Wheat planted in spring and harvested in late summer, prioritized for BNI trait integration due to its global significance in agriculture. Relevant CropSustain research locations representing key agro-ecologies include Mexico, India and Kenya.
Winter wheat	Wheat planted in autumn and harvested in summer, targeted for incorporating BNI traits to enhance its environmental and agronomic benefits. Relevant CropSustain research locations representing key agro-ecologies include Japan and Turkey.

Germplasm	Genetic resources, including seeds and breeding materials, used to develop improved crop varieties with desired traits such as BNI activity.
BNI Trait	The biological capability of certain plants to inhibit soil nitrification, improving nitrogen-use efficiency and reducing environmental nitrogen losses.
Elite BNI line	Advanced wheat lines exhibiting stable and high BNI activity, developed for superior performance in diverse agro-ecological zones.
Yield trials	Experimental field studies evaluating the productivity and performance of crops under varying conditions to determine the effectiveness of BNI traits.
N losses assessment research	Investigations using isotopes and field data to measure and quantify reductions in nitrogen losses from agriculture, including greenhouse gas emissions and nitrate leaching.
Crossing/breeding activities	Processes integrating BNI traits into high-performing wheat varieties using advanced breeding techniques and molecular tools.
Field research activities	On-site evaluations of BNI wheat performance, environmental impact, and agronomic characteristics under real-world conditions.
Nitrifier identification	Characterization of microbial communities involved in soil nitrification, crucial for understanding and optimizing BNI effects.
Nitrifier inhibition pathways	Biological and chemical pathways through which BNI compounds suppress soil nitrification processes.
Nitrifier biogeochemical analysis	Research focusing on the interaction of nitrifying microbes with soil chemistry and plant exudates in the context of BNI.
Active BNI root exudate compound	Biochemical substances secreted by plant roots that inhibit nitrification, forming the basis of BNI activity.
Nitrogen Use Efficiency (NUE)	A metric assessing how effectively plants utilize available nitrogen, crucial for reducing fertilizer use and environmental impact.

4.2. CropSustain staff list

Name	Web link
Name	Web link
KARWAT, Hannes Walter	https://www.cimmyt.org/people/hannes-karwat/
REYNOLDS, Matthew Paul	https://www.cimmyt.org/people/matthew-reynolds/
SAINT PIERRE, Carolina	https://www.cimmyt.org/people/carolina-saint-pierre/
DREISIGACKER, Susanne	https://www.cimmyt.org/people/susanne-dreisigacker/
DABABAT, Abdelfattah A.S.	https://www.cimmyt.org/people/amer-dababat/
TIWARI, Thakur Prasad	https://www.cimmyt.org/people/thakur-prasad-tiwari/
DUNSFORD, Hamish Gordon	https://www.cimmyt.org/people/hamish-dunford/
BHATI, Pradeep Kumar	not available
GERARD, Guillermo Sebastian	not available
PIXLEY, Kevin Vail	https://www.cimmyt.org/people/kevin-pixley/
GUWELA, VERONICA	not available
Sieg Snapp	https://www.cimmyt.org/people/sieglinde-snapp/
Janet Lewis	https://www.linkedin.com/in/janet-lewis-a5953759/
Tek Sapkota	https://www.cimmyt.org/people/tek-sapkota/
SHERPA, Sonam Rinchen	https://www.cimmyt.org/people/sonam-rinchen-sherpa/
AKIN, Beyhan	https://www.cimmyt.org/people/beyhan-akin/
MARENYA, Paswel	https://www.cimmyt.org/people/paswel-marenya/
SILVA CRUZ, Viridiana	not available
TERRAZO SANTANA, Luz Maria Elizabeth	not available
SANCHEZ MERAZ, Jesus	not available
CATAÑO MORA, Mariafernanda	not available
FLORES ENRIQUEZ, Osiris Dinora	not available
DELGADO FONSECA, Eulalio Roman	not available
CORTES VELAZQUEZ, J. Alejandro	not available
VELAZQUEZ PEREDO, Lorena	not available
DALE, Joe Edward	not available
CARRILLO RODRIGUEZ, Emilio	not available
MOSQUEDA LAZCARES, Gabriela	not available
Partners (non-CIMMYT)	
Cecile Gubry-Rangin	U Aberdeen, BioNI
Kristian Brandt	U Kopenhagen, BioNI
Hans Thorvaldsen	U Kopenhagen, BioNI
Kenneth Madriz Ordenada	https://plen.ku.dk/english/research/plant_soil/employees_plant_soil/?pure=en/persons/316351

4.3. Subgrant agreements

SUMMARY

Subgrant Reference Number	Organization / Institution name	In Preparation	In review by CIMMYT TC	In review by Collaborator	Signature process	Signed by the parties	1st Payment in Process
GWP-2024-113	Sejet Plant Breeding I/S,	1	1	1	1	1	1
GWP-2024-115	Aarhus University	1	1	1			
GWP-2024-116	Instituto Nacional de Investigación Agropecuaria (INIA)	1	1	1			
GWP-2024-117	University of Aberdeen,	1	1	1	1	1	1
GWP-2024-118	University of New Hampshire	1	1	1			
GWP-2024-119	Julius Kuehn-Institut	1	1				
GWP-2025-120	ICAR-IIWBR	1	1	1			
GWP-2025-121	Borlaug Institute for South Asia – (BISA)	1	1	1			
GWP-2025-122	PARC Pakistan Agricultural Research Council (PARC)	1	1				
GWP-2025-123	John Innes Center (JIC)	1					

PROGRESS

Subgrant Reference Number	Organization / Institution name	Progress
GWP-2024-113	Sejet Plant Breeding I/S,	100%
GWP-2024-115	Aarhus University	50%
GWP-2024-116	Instituto Nacional de Investigación Agropecuaria (INIA)	50%
GWP-2024-117	University of Aberdeen,	100%
GWP-2024-118	University of New Hampshire	50%
GWP-2024-119	Julius Kühn-Institut	33%
GWP-2025-120	ICAR-IIWBR	50%
GWP-2025-121	Borlaug Institute for South Asia – (BISA)	50%
GWP-2025-122	PARC Pakistan Agricultural Research Council (PARC)	33%
GWP-2025-123	John Innes Center (JIC)	17%

4.4. CropSustain Scorecard



Microsoft Excel
97-2003 Worksheet

[Scorecard CropSustainN_Timesheet_7_RY1_Compiled.xlsx](#)

4.5. ResearchFish Automatic Report

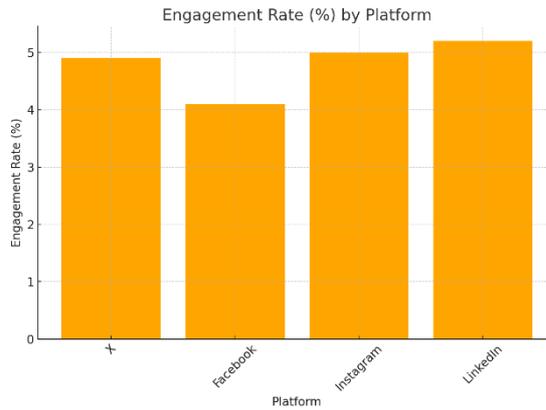
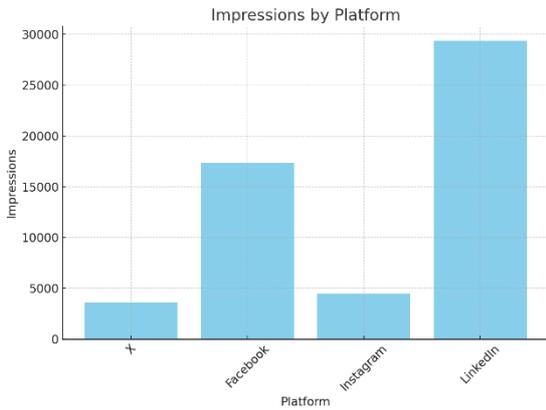
In this sub-folder, all RF reports per Research Track are documented: [ResearchFish](#)

4.6. CropSustain Digital Performance Report

(June 2024 - December 2024)

1. Overall Performance Summary

- Total Impressions: 54,826
- Average Reach per Post: 1,972.7
- Total Engagements: 2,644
- Average Engagement Rate (per Impression): 4.8%



2. Top Performing Posts

Platform	Post Type	Link
LinkedIn	Post	https://www.linkedin.com/feed/update/urn:li:ugcPost:7203874576848633860/
Facebook	Post	https://www.facebook.com/642011201304337/posts/912580560914065
LinkedIn	Share	https://www.linkedin.com/feed/update/urn:li:share:7284682131480485891/
Instagram	Reel	https://www.instagram.com/reel/C7z0U9Fsfgc/
X	Tweet	https://x.com/CIMMYT/status/1865199599750693174

Content achieved a strong overall **engagement rate of 4.8%**, surpassing non-profit benchmarks across platforms (LinkedIn - **2.1%**, Facebook - **3.8%**, Instagram - **5.6%**, and X - **3.7%**). LinkedIn stood out with the highest engagement rate (**5.2%**) and significant traffic generation through post link clicks, while Instagram delivered notable engagement despite fewer posts. The results demonstrate effective platform-specific strategies, solid content resonance, and a well-executed approach to digital outreach.



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