InnoMatch

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InnoMatch – Deep Soil Challenge Definition

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SoilPulse

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On-site nitrogen monitoring enabling precision fertilization and verified carbon sequestration

1.3 Organisation Description

DeepSoil is a leading agricultural technology company specializing in carbon credit generation and soil monitoring solutions. Founded in 2019, the company has grown to a team of 10 professionals, including agronomists, data scientists, and agricultural consultants. Operating remotely from Germany (headquarter), Serbia (Machine Learning and GIS) and Italy (Commercial) with field operations in Europe (Germany and UK), South America (Brazil and Mexico) and US, spanning approximately 300,000 hectares.

Our flagship product, SoilMind, is an integrated soil health monitoring platform that combines remote sensing, soil analysis, and agronomic advisory services. With a 6-digit annual turnover and strategic partnerships with industry leaders including Bayer CropScience and regional agricultural cooperatives, DeepSoil has established itself as a trusted partner in regenerative agriculture.

Our clients include major agricultural corporations, family-owned farming operations, and agricultural consultancies managing multi-regional portfolios. We have successfully implemented soil carbon monitoring programs on over 250 pilot farms and generated carbon credits worth €1.8 million for our farming partners since 2020. Our technical infrastructure includes a state-of-the-art soil analysis laboratory, drone fleet for remote

sensing, and a proprietary data analytics platform processing over 50,000 soil samples annually.

1.4 Challenge Description

DeepSoil generates high-integrity carbon credits by verifying carbon sequestration in agricultural soils. These credits fund climate-positive farming practices such as reduced tillage, cover cropping, and optimized fertilizer use. The global agriculture carbon market, valued at $7.5 billion in 2025, is expected to reach $20.8 billion by 2029, but credibility issues persist due to unreliable soil carbon measurement methods. High-quality credits demand accurate, repeatable data, which current laboratory testing fails to provide.

Nitrogen management is central to soil carbon retention. Excess nitrogen use accelerates carbon loss from soils and emits nitrous oxide, a potent greenhouse gas. Yet nitrogen levels are still measured through slow, expensive lab tests that deliver limited, static results. This constrains DeepSoil's ability to verify carbon credit claims, provide precision agronomic advice, and compete with more data-driven programs.

Agricultural soils have lost up to half their original carbon stocks globally, and European soils continue to erode carbon annually, representing both a climate risk and revenue opportunity. Germany alone emits around 60 million tons of CO_2 equivalent from agriculture each year, making efficient nitrogen management a national priority.

Solving this challenge matters now because regulatory pressure under the EU's Fit for 55 demands major agricultural emission reductions, market incentives for carbon credit generation are growing rapidly, and new sensing and analytics technologies finally allow real-time nitrogen monitoring at scale.

1.5 Challenge Main Objectives

The main objectives are to:

1. **Reduce carbon footprint by 20%** through optimized nitrogen management that minimizes N_2O emissions and prevents soil organic carbon degradation

2. **Decrease nitrogen fertilizer inputs by 15-20%** while maintaining or improving crop yields, through precision application based on real-time plant nitrogen status
3. **Generate premium carbon credits** by providing high-frequency monitoring data that meets rigorous MRV standards for soil carbon sequestration verification
4. **Enable data-driven co-marketing campaigns** demonstrating quantifiable environmental benefits to end consumers and corporate buyers of carbon-neutral agricultural products

These objectives directly support DeepSoil's growth strategy while advancing sustainable agriculture practices across our farm network.

1.6 Solution Functional Requirements

1.6.1 Compulsory Functional Requirements (MUST HAVE)

The solution SHALL:

1. **Nitrogen Status Measurement**
    - Provide a quantitative assessment of plant nitrogen status in agricultural field conditions
    - Achieve a minimum 80% accuracy compared to laboratory reference methods (Kjeldahl or combustion analysis)
    - Deliver results within the same working day of measurement (maximum 8 hours from sample collection to data availability)
2. **Ease of Use**
    - Enable measurements by end users (farmers, consultants, technicians) without advanced training
    - Require no calibration procedures by end users
    - Require no sample dilution or complex preparation steps
    - Function with minimal sample volumes (< 50g plant material or < 500ml liquid extract)
    - Provide clear, interpretable results (e.g., kg N/ha, % tissue nitrogen, or categorical assessment)
3. **Measurement Frequency and Scope**

- Support one-off measurements at predetermined points in time (no continuous monitoring required for pilot)
- Capable of performing measurements 4-8 times during a crop growing season
- Suitable for major European crops: wheat, barley, corn (maize), and rapeseed

4. **Data Interoperability**

   - Provide monitoring results and GPS coordinates in CSV format (minimum requirement)
   - Include metadata: measurement date/time, crop type, growth stage, weather conditions at measurement time
   - Support API access for automated data integration (RESTful API with JSON or XML responses)
   - Enable data export in standard formats compatible with major GIS and farm management software

5. **Georeferencing**
   - Capture or allow manual entry of GPS coordinates (±5 meter accuracy sufficient) for each measurement location
   - Support WGS84 coordinate system
6. **Connectivity and Data Transmission**
   - Function with limited or intermittent internet connectivity (typical farm field conditions)
   - If device-based: include mobile data solution (SIM card) or support offline data storage with later synchronization
   - If app-based: support offline mode with automatic upload when connectivity restored
7. **Language Support**
   - Provide user interface, documentation, and results reporting in English
   - Support German language for results delivery and basic operation

1.6.2 Desirable Functional Requirements (NICE TO HAVE)

The solution WOULD provide added value if it:

1. **Multi-Nutrient Analysis**
    - Provide phosphate (P) status assessment alongside nitrogen monitoring
    - **Value proposition:** Phosphate and nitrogen interact in plant metabolism and soil biogeochemistry; monitoring both enables more precise fertilization strategies and helps triangulate nitrogen-phosphorus dynamics that affect overall carbon balance. This data enriches carbon credit documentation by demonstrating holistic nutrient management.
2. **Extended Measurement Range**
    - Detect nitrogen status across full crop growth cycle from early vegetative to grain filling stages
    - Provide soil nitrogen testing capability in addition to plant tissue analysis
    - **Value proposition:** Enables year-round monitoring and better seasonal planning
3. **Enhanced Data Analytics**
    - Provide trend analysis and seasonal comparisons within the solution dashboard
    - Generate fertilization recommendations based on measurement results
    - Integrate with weather data for predictive modeling
    - **Value proposition:** Transforms raw data into actionable agronomic insights
4. **Advanced Accuracy**
    - Achieve >90% accuracy compared to laboratory methods
    - Provide confidence intervals or error estimates with each measurement
    - **Value proposition:** Supports higher-tier carbon credit standards and scientific publication of results
5. **Extended Crop Coverage**
    - Support additional crops beyond wheat, barley, corn, and rapeseed (e.g., potato, sugar beet, vegetables)
    - **Value proposition:** Expands addressable market for DeepSoil's carbon farming programs
6. **Hardware Robustness**
    - IP65 or higher rating for dust and water resistance
    - Operating temperature range -10°C to +45°C
    - Battery life supporting full day field operation (8+ hours)
    - **Value proposition:** Increases reliability and reduces maintenance in challenging field condition

1.7 Pilot Scope

The pilot will implement the nitrogen monitoring solution across 4 testing sites in different geographical regions of Central Europe, aligned with the supplier's operational base (e.g., German sites for German suppliers, Italian sites for Italian suppliers). Testing will be conducted on 4-12 field parcels totalling approximately 50-150 hectares. Each site will represent a typical family farm or agricultural cooperative operations engaged in conventional arable farming.

1.7.1 Type and number of targeted end-users

End-User Type	Roles/Engagement	N#
DeepSoil Consultants	Primary end users who will perform measurements, interpret results, and provide agronomic recommendations to farmers. They will select measurement locations using remote sensing data provided by DeepSoil and conduct 4-8 measurement campaigns per site during the growing season. Consultants will also be responsible for data quality assurance and uploading results to DeepSoil's SoilMind platform.	4
Farmers	Collaborative partners who provide field access and implement recommended fertilization practices. They will participate in solution training and provide feedback on practical usability. Farmers receive agronomic reports and are the ultimate beneficiaries of optimized fertilization strategies.	4
Agricultural Technicians	Support personnel from cooperatives or DeepSoil who assist with field logistics, sample handling if required, and equipment maintenance. They ensure measurement protocols are consistently followed across all sites.	3-4

Note: DeepSoil consultants are the primary users of the solution. They are agricultural professionals employed or contracted by DeepSoil who manage relationships with multiple farm clients (typically 15-30 farms each). Farmers are not expected to operate the solution independently during the pilot, though training them for future adoption is a secondary objective.

1.7.2 Language

- **Primary Language:** English for all technical documentation, API specifications, and results database
- **Required for User Communication:** German for:
  - User interface (device/app screens, if applicable)
  - Training materials and user manuals
  - Data reports and visualizations shared with farmers
  - Customer support communications

The supplier should provide bilingual support or German-speaking technical staff for pilot kickoff training and ongoing support.

1.7.3 Other aspects

The pilot will run over 12 months following the InnoMatch program structure. The two-month preparation phase will cover solution customization, user training, pilot site selection, baseline data collection, and the signing of a memorandum of understanding. During the six- to eight-month deployment phase, field testing will take place across two seasonal crop cycles: winter wheat from February to June and corn and rapeseed from April to August, with four to eight measurement points per field per cycle. The final two to four months will be dedicated to assessment, including data analysis, carbon credit verification, user feedback, and reporting.

The supplier will provide all necessary hardware, sensors, and test kits, handle setup, conduct on-site training, offer technical support, and replace any faulty equipment within five business days. DeepSoil will coordinate field access, supply GPS coordinates and baseline soil data, provide access to the SoilMind platform, and deliver agronomic interpretation of results. All hardware remains the property of the supplier during the pilot. If performance targets are reached and DeepSoil decides to scale, the hardware can be

purchased or leased; otherwise, the supplier retrieves it after completion. Consumables used during the pilot are non-returnable.

Since many pilot sites have limited cellular coverage, the supplier must ensure the solution operates under low-connectivity conditions. DeepSoil will provide Wi-Fi at farm headquarters for configuration and data upload. Cloud-based systems are preferred, and no dedicated IT infrastructure will be provided. Data collection will be overseen by DeepSoil consultants, while the supplier enables remote monitoring and participates in monthly technical check-ins.

1.8 Pilot Set-Up Conditions

1.8.1 Ethical, Legal or Regulatory

Data Protection: The solution must fully comply with the General Data Protection Regulation (GDPR) and relevant data protection laws within the European Union. Specifically:

- All personal data (farmer names, contact details, farm addresses) must be encrypted during transmission and storage
- GPS coordinates and other potentially identifying location data should be pseudonymized where possible
- Data processing agreements (DPAs) must be established between the supplier and DeepSoil before pilot commencement
- DeepSoil (as data controller) will ensure farmer-informed consent is obtained for data collection and sharing with the solution provider
- Data retention: pilot data may be stored for up to 5 years for carbon credit verification purposes; the supplier must confirm the ability to support this retention period

Regulatory Compliance:

- No specific ethical committee approval is required for this pilot, as it involves only standard agricultural monitoring activities
- Solution must comply with relevant agricultural input regulations if chemical reagents are used

- Any drone or aerial imaging components (if applicable) must comply with EU drone regulations

Data Access Control:

- Role-based access: Only authorised DeepSoil consultants and designated supplier support personnel shall have access to pilot data
- Audit logging: System should log all data access and modifications for traceability
- Data sharing: DeepSoil retains right to share anonymized/aggregated pilot results in carbon credit documentation and academic publications

1.8.2 Technological

System Interoperability and APIs: The solution must provide:

- **RESTful API** with the following capabilities:
  - Authentication via API key or OAuth 2.0
  - GET endpoint to retrieve measurement records with filtering by date, location, crop type
  - POST endpoint to upload new measurements (if applicable)
  - Webhook support for real-time notifications of new measurements
  - Rate limiting clearly documented
  - API documentation in English (OpenAPI/Swagger format preferred)

Data Export Requirements:

- **CSV Export (minimum):** Must include fields:
  - Measurement ID (unique identifier)
  - Timestamp (ISO 8601 format)
  - GPS Latitude (decimal degrees)
  - GPS Longitude (decimal degrees)
  - Crop Type
  - Growth Stage
  - Nitrogen Value (with units clearly specified)
  - Confidence/Quality Indicator (if available)
  - Weather conditions at measurement time (optional but recommended)

- **Additional Formats (preferred):** JSON, GeoJSON for GIS integration

Hosting and Infrastructure:

- Prefer cloud-hosted solution (AWS, Azure, Google Cloud) with servers located within EU for GDPR compliance
- If on-premise hardware is required, supplier must provide detailed hosting requirements
- System uptime SLA of ≥95% during pilot deployment phase
- Backup and disaster recovery procedures must be documented

Internet Connectivity:

- Solution must gracefully handle intermittent or limited connectivity
- Offline data collection capability with automatic sync when connection restored
- Mobile data provision: If solution requires constant connectivity, supplier should provide SIM cards or specify data requirements for DeepSoil to arrange connectivity

Software Updates:

- Supplier must provide software/firmware updates as needed during pilot
- Critical bug fixes to be delivered within 5 business days
- Updates must not require on-site visits unless absolutely necessary

1.8.3 Data Access

DeepSoil will provide the supplier with remote sensing, soil, and field data necessary for pilot execution. This includes Sentinel-2 satellite imagery at 10-meter resolution, vegetation indices (NDVI, NDRE) at 14-day intervals, and spatial variation maps defining measurement areas. Baseline soil data such as pH, organic matter, texture, and CEC, along with historical yield and fertilization records for the past three years, will be shared. GPS coordinates for measurement points and field boundaries will be delivered as shapefiles or CSV files. Additional metadata will cover crop varieties, planting and harvest dates, rotation history, and management practices. Data will be transferred securely via SFTP or controlled-access cloud storage in shapefile, GeoJSON, CSV, or Excel formats. Access is governed by an NDA and limited strictly to pilot-related activities; commercial use or resale is prohibited, and data must be deleted or returned upon pilot completion. If the solution requires further

inputs, such as real-time weather or soil moisture data, these must be specified for feasibility evaluation by DeepSoil.

1.8.4 Other

Communication and Project Management:

- Bi-weekly progress calls (30-45 minutes) between DeepSoil and supplier teams

Intellectual Property:

- Each party retains ownership of its pre-existing IP
- DeepSoil owns all agronomic insights, carbon credit methodologies, and farm data collected during pilot
- Supplier owns solution technology, algorithms, and software
- Jointly developed improvements/adaptations during pilot subject to negotiation for future commercialization

1.9 Expected Impacts and KPIs

Expected Environmental and Agricultural Impacts

The successful implementation of the nitrogen monitoring solution is expected to deliver:

1. **Greenhouse Gas Reduction:** 15-20% reduction in nitrous oxide (N_2O) emissions from pilot fields through optimized nitrogen application, equivalent to approximately 1.5-2.0 tons CO_2e per hectare annually.

2. **Carbon Sequestration Enhancement:** Improved nitrogen management will reduce soil organic matter mineralization, maintaining or increasing soil organic carbon stocks by an estimated 0.3-0.5 tons C per hectare annually.

3. **Water Quality Benefits:** 15-20% reduction in nitrate leaching to groundwater through precision fertilization, supporting EU Nitrates Directive compliance.

4. **Economic Benefits for Farmers:** €50-100/hectare annual savings from reduced fertilizer costs while maintaining yields.

5. **Carbon Credit Value Creation:** Enable generation of 1,500-2,000 premium carbon credits per year for DeepSoil's portfolio, valued at approximately €75,000-120,000 at current market rates ($50-60 per ton).

1.10 Business Opportunity

1.10.1 Market Size

The nitrogen monitoring market represents a rapidly expanding business opportunity across European agriculture. DeepSoil offers an immediate entry point through its network of over 150 cooperatives and farms managing 45,000 hectares across Germany and Central Europe. A successful pilot could scale from an initial 50 farms in year one to over 150 farms within three years, translating into annual revenue potential of up to €50,000 from measurement fees, plus recurring income from agronomic consulting services.

Germany alone offers substantial growth potential, with 11.8 million hectares of arable land and roughly 75,000 large farms ideal for precision agriculture. Adoption of digital and soil monitoring technologies is accelerating, supported by the EU's post-2022 Common Agricultural Policy funding for climate-smart farming. The total German market for nitrogen monitoring and related services could reach €3–5 million annually, with strong prospects in France, Poland, the Netherlands, Italy, and Spain, driving the European market toward €8.1 billion by 2030.

Beyond nitrogen, solution providers can expand into carbon credit verification, multi-nutrient monitoring, regenerative agriculture software, and corporate supply-chain decarbonization services. Carbon and nutrient data platforms represent a high-growth opportunity, reinforced by a projected $20 billion agricultural carbon credit market by 2029.

Partnership with DeepSoil combines immediate scale, trusted relationships, and integrated service delivery. DeepSoil manages the last mile of adoption through its agronomist network, bundling monitoring with carbon programs and compliance support. This reduces risk for suppliers and enables faster scaling across its network and, ultimately, to broader European consultancy and cooperative ecosystems.

1.10.2 Sustainability Plan

DeepSoil will scale deployment based on pilot results. Strong performance triggers immediate expansion to 20 additional farms and full rollout within a year, with long-term scaling evaluated by year two. Moderate results lead to a short extension for refinement; underperformance ends collaboration. Procurement follows evaluation in early 2026, contract negotiation by Q3, and commercial rollout by Q4.

Success depends on proven performance, cost efficiency under €20 per measurement, and supplier scalability. DeepSoil budgets up to €100,000 for adoption, offset by expected carbon credit revenues of over €75,000 yearly. Key decision-makers are the COO, Head of Carbon Credits, Lead Agronomist, and IT Manager, with board approval by month 14.

Strategically, the solution supports DeepSoil's 2025–2030 goals to expand precision agronomy and carbon credit generation. Post-pilot, DeepSoil envisions R&D collaboration under the ZIM program, co-marketing, data partnerships, and European expansion. Seedforward acts as observing buyer and potential collaborator. The pilot offers suppliers a launchpad into Germany's and Europe's fast-growing carbon farming and precision agriculture markets.