

Soil Monitoring Directive

Fenny van Egmond & Janjo de Haan



EJP SOIL
European Joint Programme



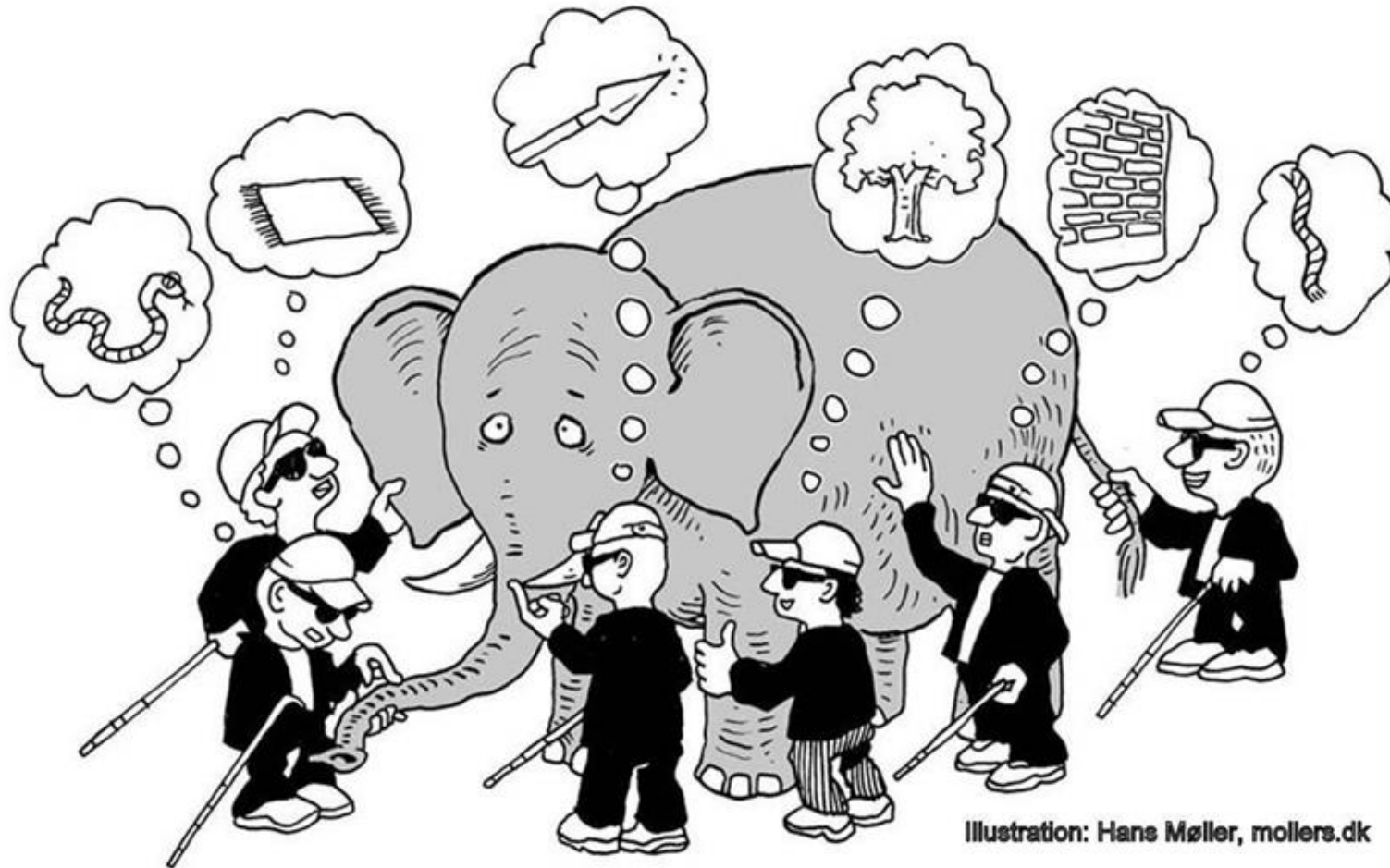
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 652615.

Programma

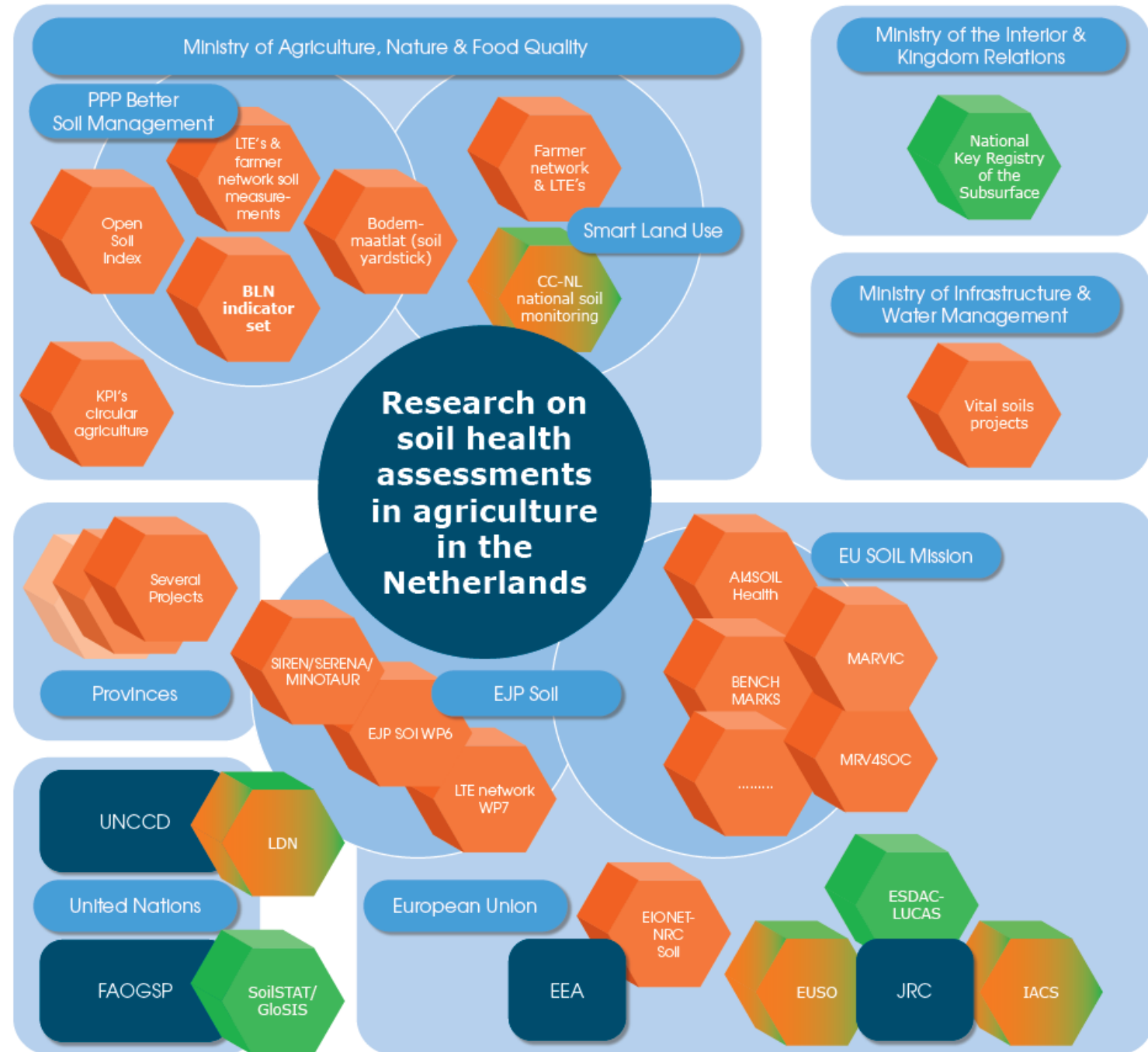
- Uitleg EU Directive on Soil Monitoring and Resilience
- Proces behandeling Soil Monitoring Directive
 - Reacties van stakeholders
 - Reacties vanuit onderzoek
- Discussie
 - Wat vinden we van de Soil Monitoring Directive?
 - Wat betekent de Soil Monitoring Directive voor Nederland?
 - Welke wetenschappelijke onderbouwing is aanvullend nodig?

Bodemkwaliteitsbeoordelingen

Blinden op zoek naar de heilige graal



Een complex landschap van onderzoek naar beoordelen van bodemgezondheid



EU - Soil Policy after failed attempt in 2006

Soil Strategy 2030 (adopted 2021)

Vision and definition for healthy soil

- **Soil health:** good chemical, biological and physical condition and provision of as many ecosystem services as possible
- By 2050, soils are healthy and resilient, which requires decisive change.
- Protection, sustainable use and restoration of soil becomes the norm.
- Solution for climate neutrality, clean circular economy, biodiversity loss, protection of human health, desertification and land degradation.



Soil Monitoring and Resilience Directive (proposal 5 July 2023)



Definition of Soil Health in the Directive

“soil health’ means the physical, chemical and biological condition of the soil determining its capacity to function as a vital living system and to provide ecosystem services.”

(article 3(4) proposed Directive)



Brussels, 5.7.2023
COM(2023) 416 final

2023/0232 (COD)

Proposal for a

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

on Soil Monitoring and Resilience (Soil Monitoring Law)

{SEC(2023) 416 final} - {SWD(2023) 416 final} - {SWD(2023) 417 final} -
{SWD(2023) 418 final} - {SWD(2023) 423 final}

Soil Monitoring in the Directive

- Monitoring, soil health districts en indicatoren, incl. land take
- Sustainable soil management practices
- Soil contamination
- [Proposal for a Directive on Soil Monitoring and Resilience \(europa.eu\)](#)



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Bodemmonitoring in de Directive

- Tot 20 % bodemmonitoring door EC, rest door MS
- Minimum set bodemindicatoren
- Aanmoediging om meer te meten, context specifiek
- Transfer functies en aanpassing van evaluatie criteria (veelal) toegestaan
- Nauwkeurigheid per soil health district en voorgeschreven meetopzet
- Evaluatie en inpassing van nieuwe wetenschappelijke inzichten in 5 jaar



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COM(2023) 416 final

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What is a Soil Health District?

Article 4

Soil districts

1. Member States shall establish soil districts throughout their territory.
The number of soil districts for each Member State shall as a minimum correspond to the number of NUTS 1 territorial units established under Regulation (EC) No 1059/2003.
2. When establishing the geographic extent of soil districts, Member States may take into account existing administrative units and shall seek homogeneity within each soil district regarding the following parameters:
 - (a) soil type as defined in the World Reference Base for Soil Resources⁷⁴;
 - (b) climatic conditions;
 - (c) environmental zone as described in Alterra Report 2281⁷⁵;
 - (d) land use or land cover as used in the Land Use/Cover Area frame statistical Survey (LUCAS) programme.

Article 5

Competent authorities

Member States shall designate the competent authorities responsible at an appropriate level for carrying out the duties laid down in this Directive.

Member States shall designate one competent authority for each soil district established in accordance with Article 4.

Minimum list Soil Health Indicators in EU Directive

Descriptor	Threshold	Adaptive to country
Electrical conductivity (sat. paste)	< 4 dS/m	No
Soil erosion rate (modelling)	<_ 2 t/ha/y	No
Soil Organic Carbon (dry combustion)	Mineral soils SOC/clay ratio > 1/13 Organic soils: national level targets	Yes
Bulk density subsoil or equivalent	Range dependent on soil texture	No
Extr. Phosphorus (P-Olsen)	< national max value	Yes, between 30-50 mg/kg
Conc. of heavy metals	No unacceptable risk for human and env. risk	
Conc. of organic contaminants (MS)	No unacceptable risk for human and env. risk	
Soil water holding capacity	Flooding/drought impact mitigated	Yes
Nitrogen in soil (Kjeldahl)	-	
Soil Acidity (pH-H ₂ O and pH-CaCl ₂)	-	
Bulk density in topsoil	-	
Soil basal respiration or other biodiversity descriptor(s)	-	

Wat moet nog bepaald worden op Member State level: in Nederland

- Soil health districts
- Data stromen
- Aanpassen van target values als goed onderbouwd
- Gevalideerde transfer functies
- Additionele bodemindicatoren nodig
- Bodem monitoring systeem ontwerp: bouwstenen van huidige monitoring systemen (BLN (CC-NL), NBI, BOBI, stedelijk/provinciaal, anderen?)
- Sustainable Soil Management Practices (database?)

Sustainable soil management practices

- Beschouwd als noodzakelijk onderdeel in wetgeving om doelen te halen
- Gekoppeld aan bijdrage van de bodem aan diverse ecosysteemdiensten
- Zorgt voor nieuwe regelgeving waaraan boeren moeten voldoen
- Op basis van bodemdata, en knelpunten in de bodemgezondheid
- Principes voor sustainable soil management vastgelegd, flexibel toe te passen
- Uitgangspunt commissie: kosten van sustainable soil management vaak lager dan economische baten en altijd lager dan milieubaten
- Complementair aan bestaande EU wetgeving
 - Koppeling met andere wetgeving
 - Stimuleren van sustainable soil management met nationale en EU-funding en private sector
 - Cruciale rol voor de CAP en Soil Mission living labs en lighthouses in implementatie van sustainable soil management practices

Wat moeten lidstaten doen?

Binnen 4 jaar:

1. Sustainable soil management practices definiëren en maatregelen die vermeden zouden moeten worden
 - In lijn met andere regelgeving, programma's doelen en wetenschappelijke kennis
 - Open inclusief en effectief proces, participatie van stakeholders
2. Gemakkelijke toegang organiseren tot onpartijdig en onafhankelijke advies, training en capacity building
3. Stimuleren bewustwording
4. Stimuleren onderzoek
 - incl. implementatie van holistische bodembeheers concepten
5. Beschikbare financieringsopties en implementatie activiteiten in kaart brengen
6. Beoordelen van de effectiviteit van de genomen maatregelen: monitoring

Sustainable soil management principles in the directive *annex III*

1. Geen kale grond
2. Minimale verstoring
3. Vermijd toepassen of vrijkomen schadelijke stoffen
4. Pas machinegebruik aan op de draagkracht van de bodem
5. Bemest naar behoefte met circulaire organische meststoffen
6. Beregen naar behoefte zonder bodemdegradatie
7. Creëer en onderhoud landschapselementen
8. Gebruik passende rassen en gewassen
9. Houd grondwaterstand hoog in veengronden
10. Gebruik diversiteit en gewasrotatie
11. Beweid vee zonder bodemdegradatie
12. Neem de juiste maatregelen om bodemkwaliteit te verbeteren bij knelpunten

Vragen inhoud Soil Monitoring Directive?



Proces

Soil Strategy 2030 (adopted 2021)

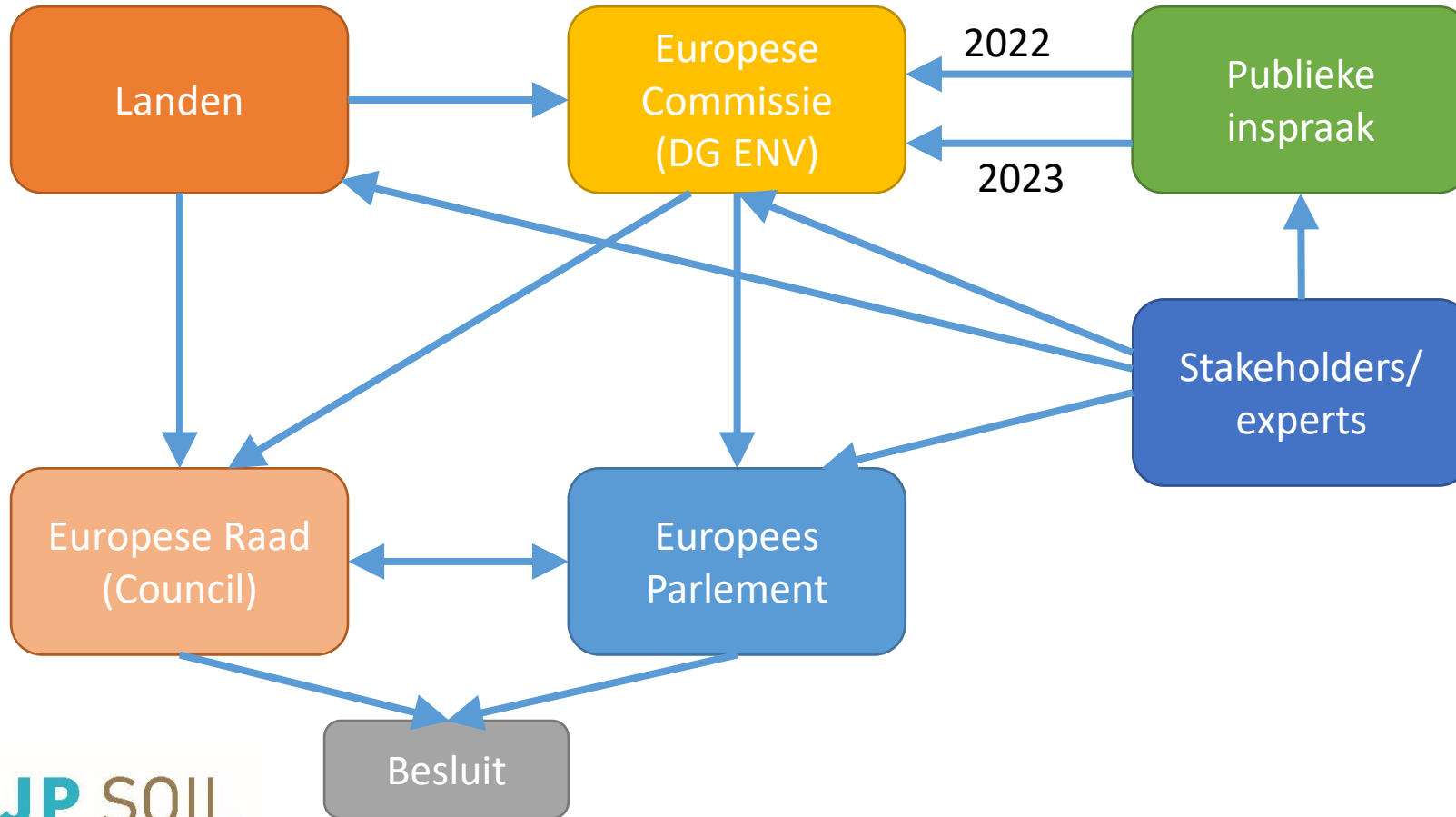
Vision and definition for healthy soil

- **Soil health:** good chemical, biological and physical condition and provision of as many ecosystem services as possible
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Soil Monitoring and Resilience Directive (proposal 5 July 2023)



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Proces tot nu toe

- Meepraten in EU Expert Group on the Implementation of the EU Soil Strategy (ministeries (IenW, LNV))
- [Soil health – protecting, sustainably managing and restoring EU soils \(europa.eu\)](https://europea.eu)
- Public feedback in 2022 – 189 zienswijzen ingediend
- Schrijven van de Directive en interne procedures
- Extended EU expert group incl. experts en stakeholders
- Publicatie Directive



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Log in

EN English

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Search

Law

Soil health – protecting, sustainably managing and restoring EU soils

Have your say > Published initiatives > Soil health – protecting, sustainably managing and restoring EU soils



About this initiative

Summary

Soils are crucial for food, nature and our economy and deserve the same level of protection as water, air or the marine environment. The aim of the Soil Health Law proposal announced in the EU soil strategy for 2030 is to:

- specify the conditions for a healthy soil
- determine options for monitoring soil and
- lay out rules conducive to sustainable soil use and restoration.

Topic

Environment

Type of act

Proposal for a directive

Call for evidence

FEEDBACK: CLOSED

Feedback period

16 February 2022 - 16 March 2022 (midnight Brussels time)

[View feedback received >](#)



Call for evidence for an impact assessment - Ares(2022)1132884
English (269.8 KB - PDF - 4 pages)

Download

Proces tot nu toe en wat er nog komt

- Impact assessments op landelijk, provinciaal, gemeentelijk niveau
- Visie van ministeries verwoord naar de minister en Tweede Kamer
- Reacties van belanghebbenden in de media
- Ontwikkelen van gezamenlijke wetenschappelijke reactie ([brief](#)) EU niveau
- Inspraak van stakeholders bij EU Parlement rapporteur(s) for the Committee on the Environment, Public Health and Food Safety
- [Draft report](#) of the Committee on the Environment, Public Health and Food Safety
- Council: landen kunnen vragen stellen per brief - Tweede Kamer o.a. over subsidiariteit
- Publieke feedback periode – 205 zienswijzen ingediend


- Behandeling in Europees Parlement (amendementen?)
- Behandeling in European Council (amendementen?)
- Vergaderingen volgens normale en interinstitutionele route, o.a. Working Party on Environment voor Council
- Mogelijke adoptie van de Directive (voor de EU verkiezingen, juni 2024)

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Proces wat er nog komt

- [Overview | Ordinary legislative procedure | Ordinary Legislative Procedure | European Parliament \(europa.eu\)](#)
- [Interinstitutional negotiations | Ordinary Legislative Procedure | European Parliament \(europa.eu\)](#)



The three phases of ordinary legislative procedure

Soil Strategy 2030 (adopted 2021)

Soil Monitoring and Resilience Directive (proposal 5 July 2023)

Soil health: good chemical, biological and physical condition and provision of as many ecosystem services as possible

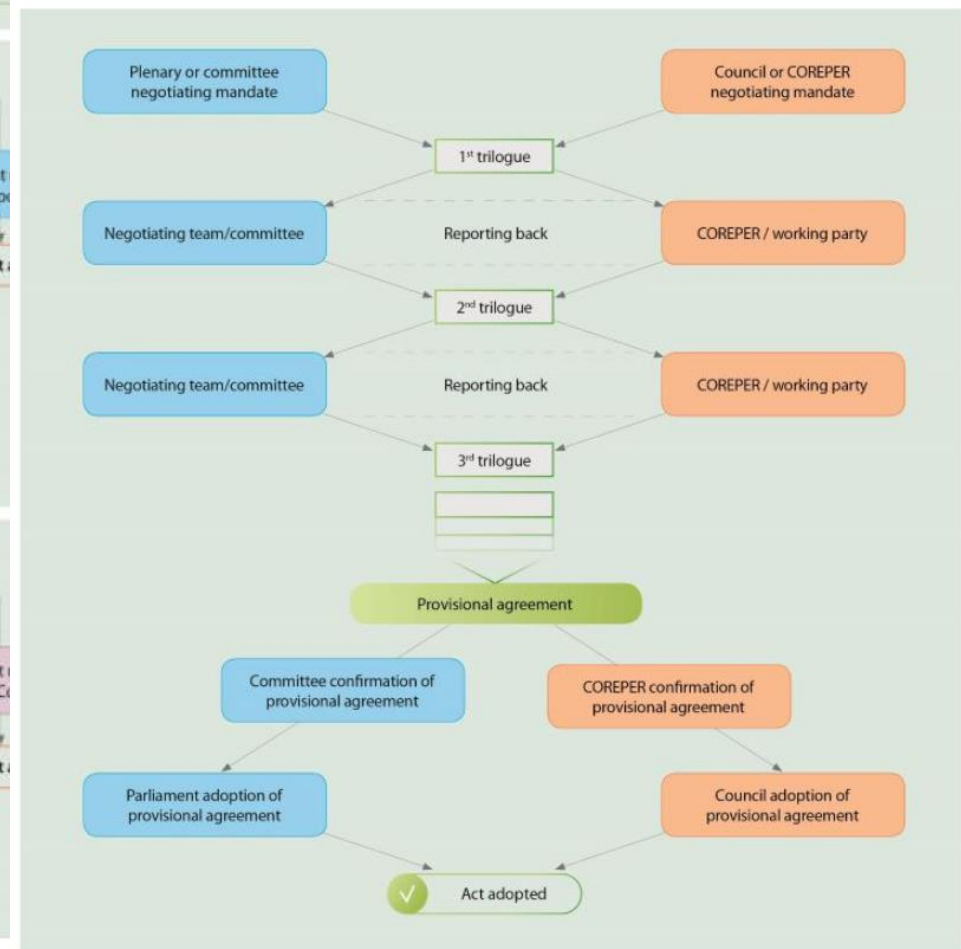
By 2050, soils are healthy and resilient, which requires decisive change.

Protection, sustainable use and restoration of soils becomes the norm.

Contribution for climate neutrality, clean circular economy, biodiversity loss, protection of human health, desertification and land degradation.

European Commission

SOIL
an EU Joint Programme



Steps in the negotiation process

Proces tot nu toe en wat nog komt

- Mogelijke adoptie van de Directive (voor de EU verkiezingen, juni 2024)
- Transpositie naar nationale wetgeving
- Implementatie

- 2026/2027 volgende LUCAS campagne
- Continue ontwikkeling van EUSO Soil Health Dashboard (komen data samen)
- Einde van de Mission Soil in 2027 (financiert nu veel EU bodemonderzoek)
- Evaluatie van de Directive in 2029? En mogelijkheid tot aanpassen o.a. o.b.v. onderzoek

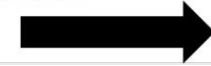
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EJP SOIL
European Joint Programme

Soil Monitoring and Resilience Directive
(proposal 5 July 2023)



Reacties van stakeholders op websites/nieuws

EURACTIV

Commission tables first EU soil law, slammed for 'lacking ambition'



Vewin Den Haag Vewin Brussel Contact

English Privacy Policy | 🔍 ☰

6 juli 2023

Relatie tussen (grond)water en bodem moet duidelijker in nieuwe Bodem Monitoringswet

Behoeftte aan verbinding met andere relevante EU-richtlijnen.

NIEUWS - 5 JULI 2023

Extra beperkingen door EU voorstel voor Bodemmonitoringsrichtlijn

Ref. COMM(23)03809
05/07/2023

Statement

New pillar of the farming Green Deal, the EU soil monitoring law is considered as acceptable by Copa and Cogeca



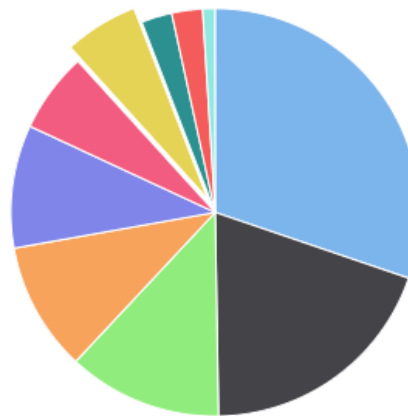
NEWS 05 July 2023

Today the European Commission introduced its proposal for a Soil Monitoring Directive. While the proposal provides important recognition of the need for rapid action to halt and reverse soil degradation, the very small steps proposed fall far short of the level of action needed.

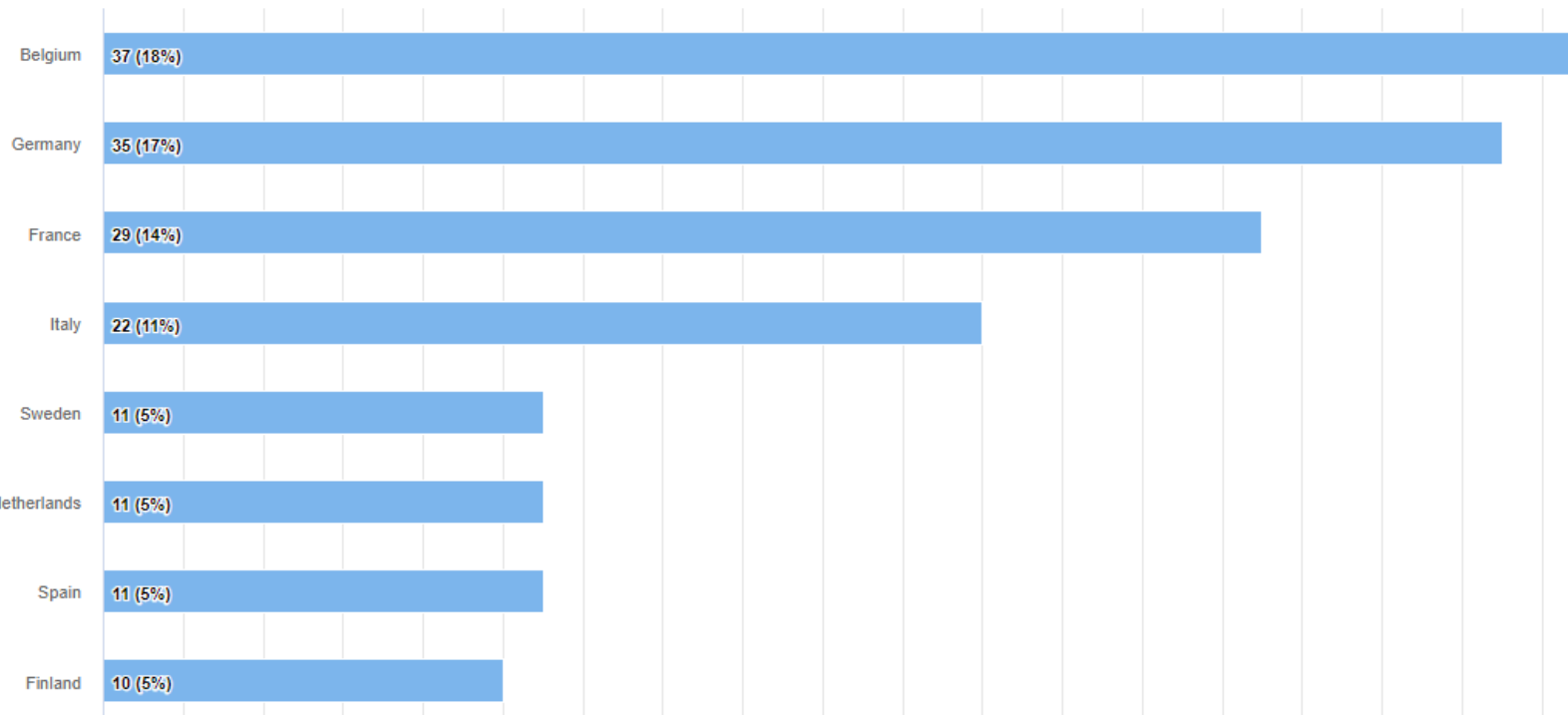
Feedback nov. 2023

By category of respondent

- Business association: 62 (30.24%)
- EU citizen: 40 (19.51%)
- Non-governmental organisation (NGO): 25 (12.20%)
- Company/business: 21 (10.24%)
- Other: 20 (9.76%)
- Public authority: 13 (6.34%)
- Academic/research Institution: 12 (5.85%)
- Environmental organisation: 5 (2.44%)
- Non-EU citizen: 5 (2.44%)
- Trade union: 2 (0.98%)



By country



Unique feedback (205) | Statistics

Filter reviews by | Showing results 1 to 10

Keywords

Order by
Most recent

Clear filters

03 November 2023 | Other
EJP Soil - MINOTAUR project consortium (Italy)
FEEDBACK TO THE SOIL MONITORING LAW FROM THE EJP SOIL MONOTAUR ON SOIL BIOLOGICAL INDICATORS As a premise to underline that we fully support a proposal for a Directive on soils, w protection and tries to counter the threat of degradation. However, a project entitled Modelling and mapping soil biodiversity patterns an

03 November 2023 | Non-governmental organisation (NGO)
Baltic Sea Action Group (Finland)
Proposal for an EU Soil Monitoring Law FEEDBACK TO PUBLIC CONSULTATION ON SEA ACTION GROUP AND THE CARBON ACTION/STN MULTICOUNTRY AS A joint contribution of the Finnish Carbon Action platform and the Baltic Sea Action Group, as the host of the platform, puts forth the following Soil Monitoring Law as contained in COM(2023) 416 final and its ar

03 November 2023 | Environmental organisation
Zero Waste Alliance Ireland (Ireland)

Wat vindt de wetenschap?

- Meten is weten, harmonisatie is nodig
- Meer flexibiliteit
 - om bestaande monitoring systemen mee te nemen,
 - context specifiek,
 - Meerdere indicatoren per functie
 - Evaluatie criteria
- Focus op ecosysteem diensten en bodemfuncties (tiered aanpak)
- Biodiversiteit indicatoren kunnen beter
- Niet alleen metalen maar ook andere verontreinigingen meten
- Risico beoordeling methode (harmoniseren)

The Soil Monitoring and Resilience Directive:

Scientific Response Document

SUMMARY

On the 5th July 2023, the European Commission presented its proposal for a new **Directive for Soil Monitoring and Resilience** (COM(2023) 416). This letter provides a **shared scientific evaluation** of the proposal which has been co-signed by scientific organisations across the European Union. We support that the proposal focuses on three main pillars: 1) the monitoring of soil health, 2) promotion of sustainable soil management practices, and 3) reducing risks related to contaminated land.

We **welcome this proposal for a Directive** as crucial means to legally protect soils as an essential part of the ecosystem. Nevertheless, we have concerns regarding the level of ambition with respect to sustainable soil use and soil health indicators, and the level of protection of sites with soil contamination. We also note that there are no legal provisions for compensation measures are included in the draft of the soil monitoring law.

As **60-70%** of Europe's soils are presently considered **unhealthy**, and in light of their continued degradation, we hope this evaluation and our recommendations for improvement will support the further development and discussion of the proposed Directive to ensure that the Directive is underpinned by the most recent scientific evidence on soil health. Finally, we would like to emphasise the importance of the Soil Mission and associated Horizon Europe, EJP Soil as well as relevant national research projects in delivering the urgently needed scientific and societal underpinning for this proposed Directive.

RECOMMENDATIONS FOR STRENGTHENING THE PROPOSED SOIL MONITORING DIRECTIVE

1. Monitoring soil health

Objectives

25 instituten, 16 projecten, 89 onderzoekers, 90 onderzoekers van WUR

Wat vindt de wetenschap?

- Belangrijke punten
 - Context specifiek
 - Naast selectie van juiste maatregelen ook juiste toepassing
- Mix van acties nodig → opgenomen in directive

- Aanbevelingen
 1. Koppel maatregelen aan de principes van de directive
 2. Creer een database met mogelijke maatregelen
 - Met informatie over effectiviteit en toepasbaarheid
 - Contextspecifiek
 3. Maak verplichtingen voor landgebruiker duidelijker en maak deze bindend
 4. Stel realistische doelen met tussenstappen

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RECOMMENDATIONS FOR STRENGTHENING THE PROPOSED SOIL MONITORING DIRECTIVE

1. Monitoring soil health

Objective

Discussie



EJP SOIL
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Wat vinden we van de Soil Monitoring Directive?



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Welke wetenschappelijke onderbouwing is aanvullend nodig?



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Bedankt!

Fenny.vanEgmond@wur.nl, Janjo.deHaan@wur.nl



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Betekenis voor Nederland

- We werken hier al aan
 - o.a. Nationaal Programma Landbouw Bodems, EJP SOIL, CC_NL, kennisprogramma DAW en in ander onderzoek
- Veel vrijheid binnen de regels om het zelf in te vullen
 - Noodzakelijk want duurzaam bodembeheer is maatwerk
- Eerste overzicht van maatregelen voor duurzaam bodembeheer in de landbouw in NL beschikbaar
 - Kan verder verfijnd en uitgewerkt worden
 - Voor ander landgebruik (stedelijk gebied, bos en natuur) nodig
- Monitoring van toepassing van duurzaam bodembeheer ontbreekt nog
- Doen we voldoende aan?
 - Advies, training, capacity building
 - Bewustwording
 - Land take

Verder onderzoek

1. Hoe combineer je resultaten van bestaande monitoringsystemen
2. Hoe kun je (veilig) bodemdata van verschillende bronnen combineren
3.?

Wrap up

1. Wat vinden we van de Soil Monitoring Directive?
 - Wat zijn goede punten?
 - Wat zijn aandachtspunten?
2. Waar zou beleid nog over na moeten denken in Nederland?
3. Welke wetenschappelijke onderbouwing is aanvullend nodig?
 - Binnen EJP SOIL
 - In vervolg op EJP SOIL (2.0), Roadmap EJP SOIL
 - Daarnaast
 - In Nederlands onderzoek

Questions to answer:

- Do EU and national monitoring objectives align?
- At what level of detail (in space and time) do we want soil monitoring information?
- Which monitoring systems can we/do we want to combine (BLN (CC-NL), NBI, BOBI, urban/provincial, others)?
- Does the result provide the information needed to take action?
- How will data flow and become available?

Soil Data Infrastructure






- Find soil data across countries
- Facilitate (tools and standards for) standardised data exchange
- Provide guidance

- BRO at present cannot accommodate soil indicator results
- BRO does not comply with international standards (O&M)
- Mandatory by law to use and provide to BRO: advanced

The screenshot shows the EJP SOIL catalogue website. The URL is <https://catalogue.ejpsoil.eu/collections/metadata:main/items?q=soil+netherlands>. The page displays the EJP SOIL logo and the title 'Basisregistratie Ondergrond - Soil face research'. The entry is categorized as 'EJP Country survey', 'Netherlands', and 'Dataset'. It includes a map of the Netherlands, a 'soil face description', 'Contacts' (Ministry of the Interior and Kingdom Relations), 'Temporal' information (Created: 1985-present, Updated: 2023-07-03, Temporal extent: 1985-present), 'External identification' (a link to the profile description), and 'License' (www.broloket.nl or www.pdok.nl). The page also shows a 'Prev' button and 'Showing 4 of 4 results'.

D6.2 Report on the national and EU regulations on agricultural soil data sharing and national monitoring activities

POINT DATA	VECTOR	RASTER
		
<ul style="list-style-type: none"> ■ Yes, conditions and limitations to access to soil point observations are in force ■ No, there are no conditions and limitations to access to soil point observations ■ It depends on the soil data owner ■ Did not answered to the questionnaire ■ No-EJP SOIL countries 	<ul style="list-style-type: none"> ■ Yes, conditions and limitations to access to soil polygon maps are in force ■ It depends on the soil data owner ■ No, there are no conditions and limitations to access to soil polygon maps ■ There are no soil polygon maps ■ Did not answered to the questionnaire ■ No-EJP SOIL countries 	<ul style="list-style-type: none"> ■ No, there are no conditions and limitations to access to soil grids ■ It depends on the soil data owner ■ Yes, conditions and limitations to access to soil grids are in force ■ There are no soil grids ■ Did not answered to the questionnaire ■ No-EJP SOIL countries
<ol style="list-style-type: none"> 1. SOIL DATA OWNER INTERESTS PROTECTION(8/16) 2. GDPR(6/16) ← = soil property/farmers 3. CONDITIONS TO THE REUSE (5/16) 4. IPR (3/16) 	<ol style="list-style-type: none"> 1. IPR(5/16) ← authorship 2. SPECIFIC LICENSES(2/16) 	<ol style="list-style-type: none"> 1. CONDITIONS TO THE REUSE(4/16) 2. SPECIFIC LICENSES(3/16) 3. IPR(2/16) ← authorship <p style="text-align: right;">local governance ↗</p>



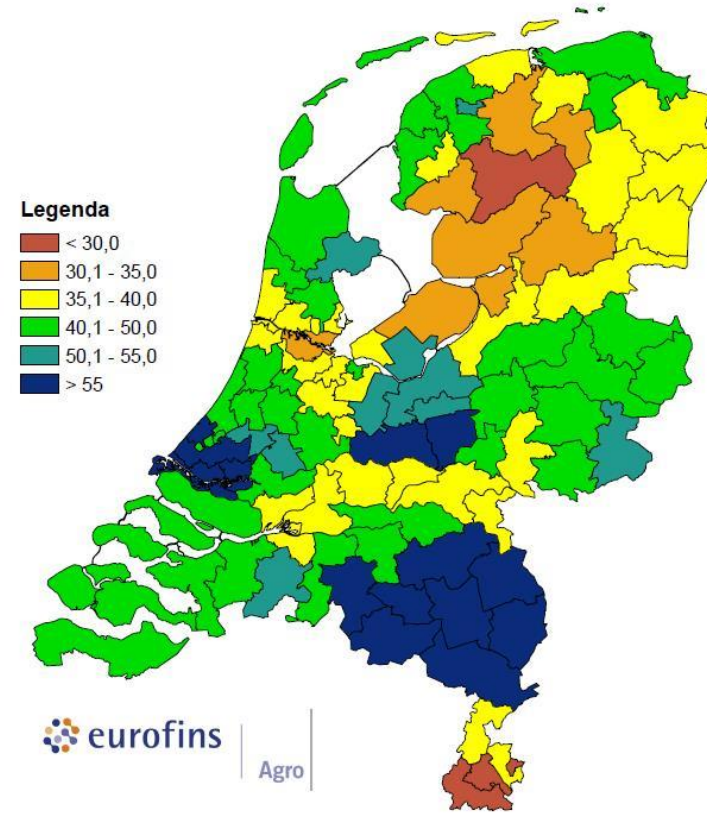
ONLINE:

<https://ejpsoil.eu/knowledge-sharing-platform/ejp-soil-publications/soil-data-monitoring-mapping-and-modelling>

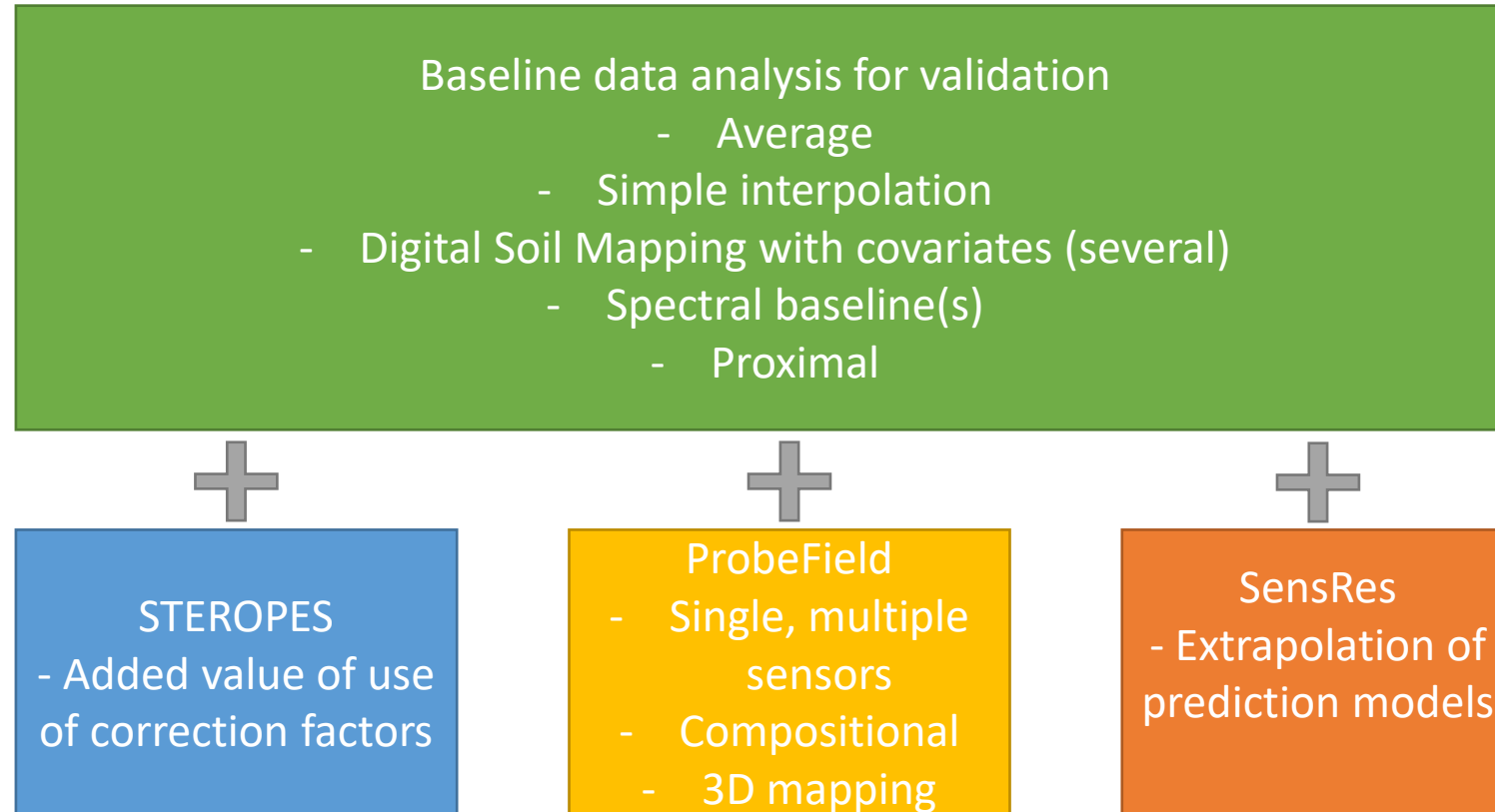
Impact NL of proposed criteria soil indicators

- Loss of soil carbon:
 - Mineral soils: SOC/Clay ratio $> 1/13 \rightarrow$ challenge for arable soils on clay
 - Organic soils: in line with nature restoration law \rightarrow rewetting 25% of area organic soils under agriculture
- Nutrient content in soil:
 - P-Olsen $< 30-50$ mg/kg \rightarrow large area of agricultural soils is above this limit
- Very likely that many Dutch agricultural soils will be indicated as unhealthy, however, restoration on short-term is unlikely

Grasland PAL ($P_2O_5/100$ g)
periode 2016-2020



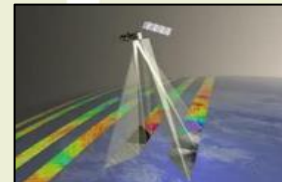
EJP SOIL – soil sensing projects



- All are on method improvement
- Validation of methods through literature and field data analyses

Sensing related projects

- SensRes: using sensor data for downscaling digital soil maps to higher resolutions
 - WP on UAV sensors for downscaling
 - Two case studies (Wageningen (Plassteeg), Spanje)
- STEROPES: improving SOC estimation from remote sensing (EO) by correcting for disturbing factors. 2021-2023 (36 months)
 - Test improvement per factor and together compared to DSM (validation)
 - Evaluate results in different agro-ecological zones
- ProbeField: improving SOC and soil fertility estimation based on proximal sensors and existing soil spectral libraries, incl 3D mapping. 2021-2024 (36 months)
 - Test applicability in accuracy and costs of single and combinations of proximal soil sensing techniques and other data sources for soil property prediction
 - Derive best practice advice for converting 1 or 2D measurements into 3D information on soil properties
- EJP SOIL T6.4: improving methodologies: synergy between projects and final advice

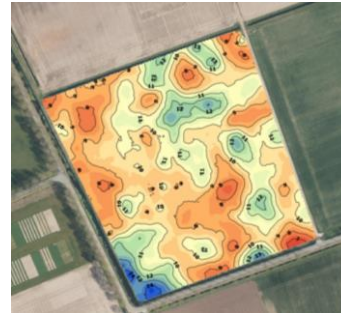


WP 4 Providing basis for selection of methods for point and 3d field estimation of soil properties

- Aims:
- Evaluation of costs and accuracy for using single and multiple proximal soil sensing techniques for estimation of soil properties
- Compositional analysis of soil properties
- 3D mapping of soil properties based on proximal soil sensing

Soil properties:
 SOC, soil inorg. C
 Clay, sand, silt
 Water content
 EC
 Coarse fragments Bulk
 Density
 Soil depth/ comp. layer

Sensing:
 Near infrared
 Gamma-ray
 EMI
 GPR

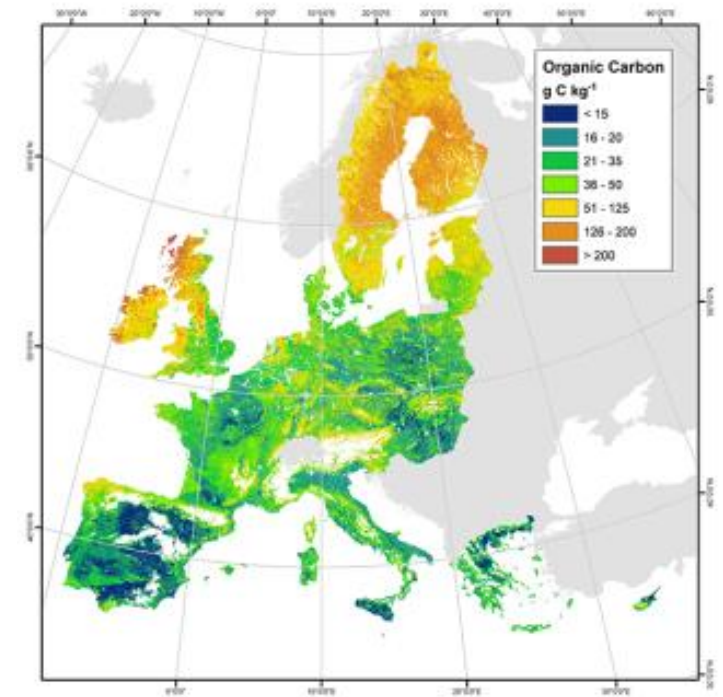


Methods:
 Literature
 Company
 survey
 Field analyses

Read by	DOI	Authors	Title	Year	Relevant (yes/no)	3d map (yes/no)	Remote sensors (yes/no)	Sensor	Manufacturing company	Measurement type (lab, in-situ, UVA, satellite)
Melis	https://doi.org/10.1016/j.geoderma.2021.114981	Moura-Bueno et al	Environmental covariates improve the spectral predictions of organic carbon in subtropical soils in southern Brazil	2021	yes	no	no	FieldSpec 3 spectroradiometer	(Analytical Spectral Devices, Boulder, USA)	lab
Roberto	https://doi.org/10.1016/j.geoderma.2019.113900	Hutengs et al	In situ and laboratory soil spectroscopy with portable visible-to-near-infrared and mid-infrared instruments for the assessment of organic carbon in soil	2019	yes	no	no	high-performance handheld MIR spectrometers, and Vis-Nir spectrometer	Agilent Handheld FTIR series (Agilent Technologies, Santa Clara, USA), that cover the 4000-650 cm ⁻¹ and ASD FieldSpec	in-situ and lab

LUCAS (Land Use/Cover Area frame statistical Survey)

- Europese landgebruiks en bodemmonitoring sinds 2009 op verzoek van het Europese Parlement
- Doel: gestandaardiseerd inzicht in staat en ontwikkeling EU bodems als basis voor beleid
- Uitgevoerd door EUROSTAT en JRC, ism DG-AGRI
 - 2009: 23 MS: 20.000 locations (~ 200 in NL)
 - 2015/2018: 28 MS: 22.000 locations (~ 200 in NL)
 - 2022: 40.000 locations (895 in NL)
- 2026: verdere integratie met nationale monitoring systemen naar EU Soil Observatory
- Puntdata wordt door JRC verwerkt naar kaarten en statistieken en wordt gebruikt voor reporting namens de EU



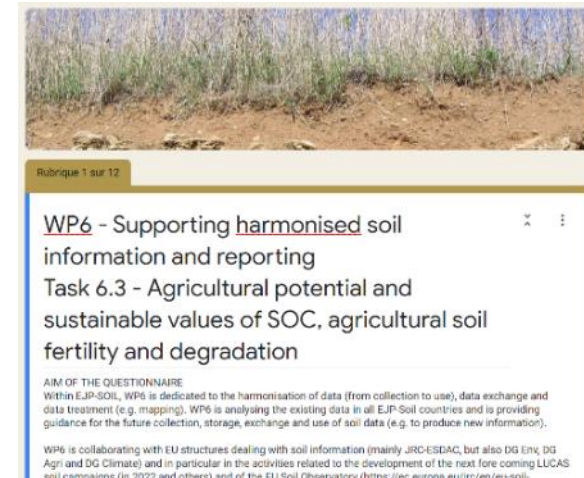
LUCAS Soil Modules over the sampling years

MODULE	Type of analysis	Year of survey		
		2009–2012	2015	2018
MODULE 1 Physico-chemical properties	Coarse fragments (>2 mm)/% PSD ¹ : clay, silt, sand/% pH (CaCl ₂ , H ₂ O) Organic carbon/g kg ⁻¹ Carbonate content/g kg ⁻¹ Total nitrogen content/g kg ⁻¹ Extractable potassium content/mg kg ⁻¹ Phosphorous content/mg kg ⁻¹ Cation exchange capacity/cmol(+) kg ⁻¹ Electrical conductivity/mS m ⁻¹ Metals Multispectral properties Mineralogy	█	█	█
MODULE 2 Soil biodiversity	Bacteria and Archaea (16S rDNA) Fungi (ITS) Eukaryotes (18S rDNA) Microfauna (nematodes) Mesofauna (arthropods) Macrofauna (earthworms) Metagenomics			█
MODULE 3 Bulk density	Bulk density Soil moisture			█
MODULE 4 Field measurements	Soil erosion by water and wind Thickness of organic layer in Histosols Soil structure			█
MODULE 5 Pollution	Organic pollutants Pesticides residues			█

CC-NL monitoring in the Netherlands
2018:
SOM, SOC, TOC, TIC,
texture, pH, N_{tot},
St_{ot}, fractions of C

Activities linked to soil monitoring

- Collaboration with LUCAS 2022 campaign to define/identify additional sampling points
- Stocktake the description of national soil datasets and monitoring networks across EJP SOIL partners. [D6.1](#), [D6.3](#), [catalogue](#)
- Comparison of monitoring results per country: national – LUCAS
- Double sampling campaign with LUCAS2022 to derive (validated) lab transfer functions: national – LUCAS
- Evaluation of evaluation criteria/thresholds
- Method development: combine data from different sampling designs/monitoring systems
- Soil indicator inventory, development to ecosystem services and soil biological indicators
- Harmonised national – EU soil mapping (method) development
- Soil data infrastructure development and standardisation in EU towards EU Soil Observatory, incl. guidance
- Soil sensing method improvement, cost/accuracy evaluation
- Science to policy [workshops](#) and [webinars](#)



Towards climate-smart sustainable management of agricultural soils

Deliverable 6.3

Proposal of methodological development for the LUCAS programme in accordance with national monitoring programmes

Due date of deliverable: M18
Actual submission date: 31.07.2021

Monitoringssystemen LUCAS, CC-NL

EU Directive	BLN/ CC-NL	LUCAS
Electrical conductivity	-	Electrical conductivity
Soil erosion	only impacts part of the country ⁻¹	
Organic carbon	Organic carbon	Organic carbon
Bulkdensity of the subsoil	Bulkdensity of the subsoil	
Extractable phosphorus (P_Olsen)	Extractable phosphorus (P_CaCl2, P_Al, P-ox)	P (Phosphorus)
Soil contamination (heavy metals)	Data available locally ⁻²	
Water holding capacity	Can be calculated ⁻³	
Bulkdensity of the topsoil	Bulkdensity of the topsoil	K (Potassium)
Soil basal respiration <i>or other</i>	-	-
pH	pH	pH (CaCl2/H2O)
N (Nitrogen)	N (Nitrogen, N_total)	N (Nitrogen)
-	Aluminium oxalaat	Aluminium oxalaat
-	IJzer oxalaat (Fe-ox)	IJzer oxalaat (Fe-ox)
-	Zandgehalte	Zandgehalte
-	Kleigehalte	Kleigehalte
-	Siltgehalte	Siltgehalte
-	Calciumcarbonaat	Calciumcarbonaat
-	Bindingscapaciteit kleihumuscomplex (CEC, CaCEC, KCEC, NaCEC, MgCEC)	-
-	Totale koolstof (C_totaal)	-
-	Inorganische koolstof	-
-	Organische stof (Gloeiverlies, NIRS)	-
-	PLFA totaal, PLFA schimmels, PLFA bacteriën	-
-	Fosfaatbindend vermogen (FBV)	-

LUCAS – National soil monitoring systems intercomparison - LUCAS double sampling campaign



Analytical procedures

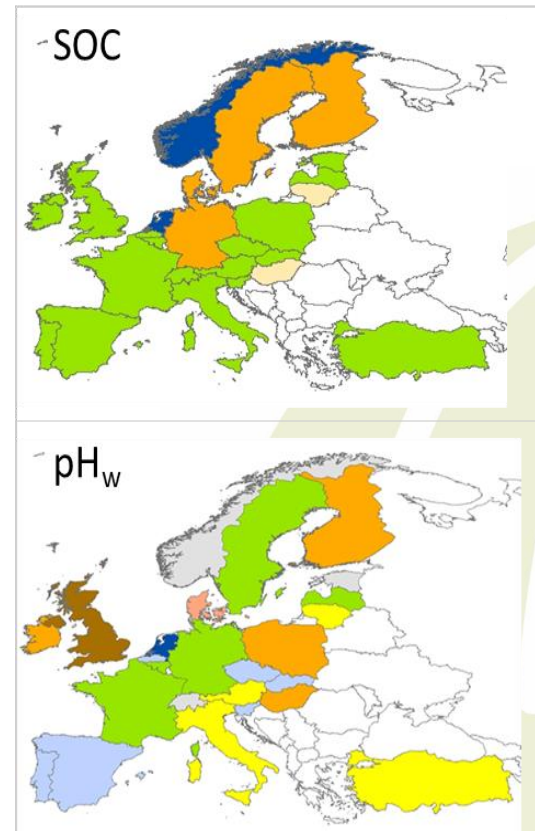
- Double samples obtained from LUCAS 2022 samplers
- Between 100 and 200 sites will be analyzed depending on the countries
- 17 countries involved
- Comparison of EU and national results



Sampling and analytical procedures

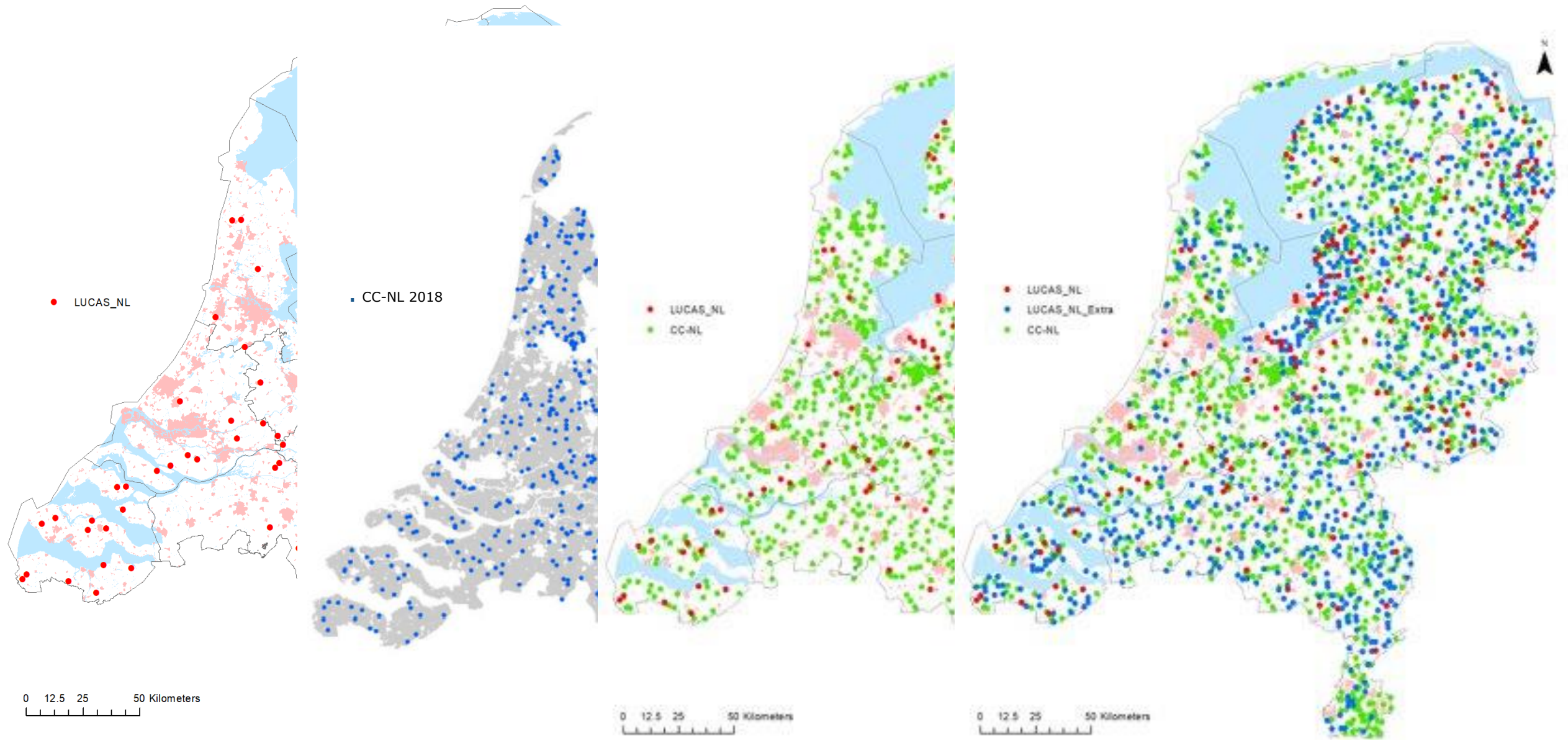
- Sampling (on national SMS and/or on LUCAS 2022 points) according to national and LUCAS sampling protocols
- 6 countries involved
- Compare the overall process

THE EXPECTATION IS PRODUCING LAB METHOD TRANSFER FUNCTIONS

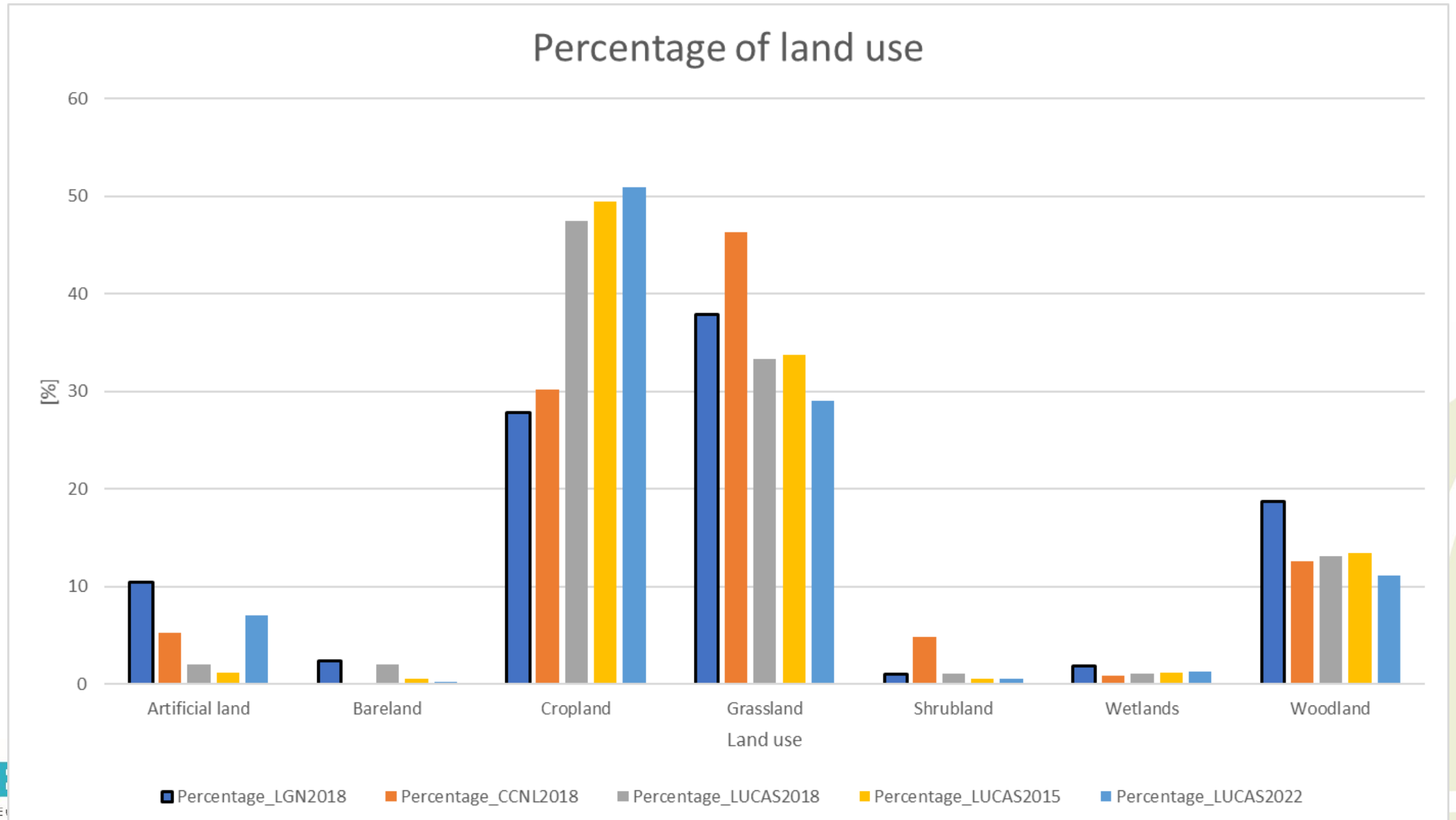


Lab methods of national soil data

Monitoring in the Netherlands - LUCAS



Landcover percentages LGN (actual), Dutch CC-NL, LUCAS



Soil monitoring

Significance of the proposed Directive to monitoring in the Netherlands:

- More detail spatially
- Once the monitoring system, incl. transfer functions has been established, up to 20 % free data
- Continuation of existing systems possible
- Learning from other countries easier
- Joint assessment of different land uses

Questions to answer:

- Do EU and national monitoring objectives align?
- At what level of detail (in space and time) do we want soil monitoring information?
- Which monitoring systems can we/do we want to combine (BLN (CC-NL), NBI, BOBI, urban/provincial, others)?
- Does the result provide the information needed to take action?
- How will data flow and become available?

LSK locations: 1998

The 'Landelijke Steekproef Kaarteenheden' (LSK) started in 1988, to describe the map units and determine the accuracy of the soil map of the Netherlands (1:50.000).

- 1392 locations
- Stratified random sampling: metrics
- 96 strata determined based on soil type and groundwater depth regimes
- Achieved a good geographical, soil and hydrological typology across the country
- Sampled according to horizons, multiple depths, range of soil properties, pedotransfer functions for bulk density
- Used for LULUCF reporting (remodelled to LULUCF soil classes and land use types)



LSK 1998 repeated in 2018: CC-NL

- Revisited LSK points
- Used LUCAS sampling protocol but:
 - replaced spade with auger
 - added penetrometer
 - bulk density with auger (unreliable also due to extremely dry summer)
- Layer sampling instead of horizons (0-30, 30-100 cm)
- Aim is to:
 - Determine SOC stock differences in 20 years
 - Aim to characterise soils of NL (N, CN etc):
 - Baseline measurement for monitoring in the future
- Multiple soil parameters (SOM, SOC, TOC, TIC, texture, pH, N_{tot}, Stot, fractions of C)
- Dutch soil monitoring (method and results) is largely comparable with Belgium and Denmark

Vragen en discussie monitoringssystemen



Definities sustainable soil management (practices)

Sustainable soil management: soil management practices that maintain or enhance the ecosystem services provided by the soil without impairing the functions enabling those services, or being detrimental to other properties of the environment

Soil management practices: mean practices that impact the physical, chemical or biological qualities of a soil

Land take

- Land take = de omzetting van (semi-)natuurlijk land in kunstmatig land
- Doel: Beperken van het verlies van de capaciteit van de bodem om meerdere ecosysteemdiensten te leveren
 - Doel ook voorkomen van Soil Sealing
- Wat wordt gevraagd aan landen
 - Het monitoren van land take
 - Het beperken van land take
 - Aanwijzen van gebieden waar verlies van functies wordt beperkt
 - Negatieve gevolgen zoveel mogelijk te beperken
 - Verlies van capaciteit zoveel mogelijk te compenseren
- Land take is vaak ook verlies van vruchtbare landbouwgrond