

CUP4SOIL

User requirements for a Copernicus Land Monitoring Service including soils

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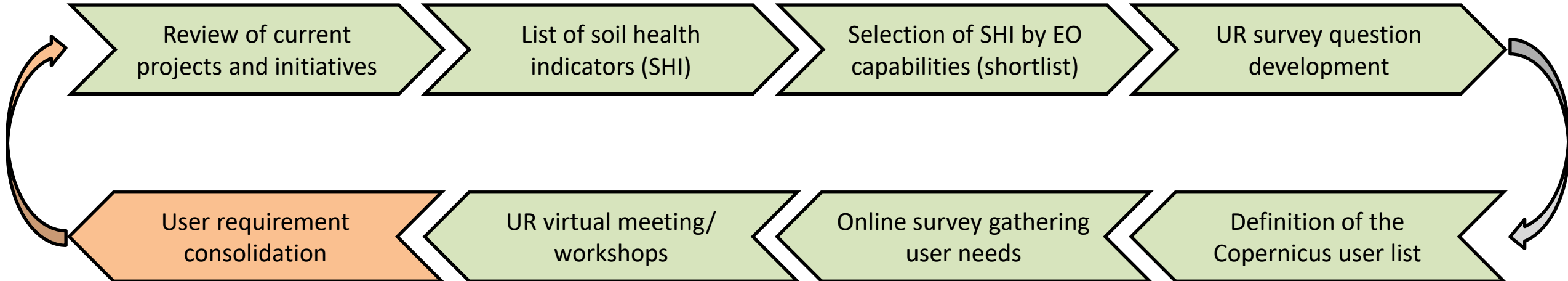
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Knowledge for Tomorrow

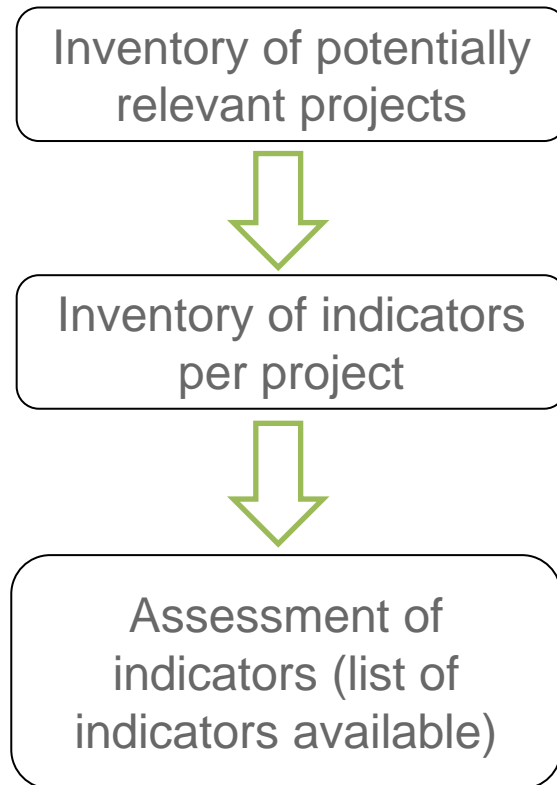


User requirements

- Reviewing existing projects and initiatives: list of potential soil health indicators
- User requirement survey: indicators and specs needed
- User requirement meeting: indicators and specs needed
- Feedback from case study results: showcases
- User requirements report



User requirements from existing projects / initiatives



- EJP SOIL (SIREN, SERENA, MINOTAUR, WP6, STEROPES)
- WorldSoils
- EEA level1
- LUCAS
- MARVIC, MRV4SOC
- ENVASSO
- EU Soil Monitoring Directive
- Status of the World's Soil Resources (GSP)
- LANDMARK
- ISQaPer
- RECARE
- BENCHMARKS, AI4SoilHealth
- PREPSOIL
- Etc.

CUP4SOIL – User Requirement Study

Shortlist



- When listed more than 4 times in the mentioned projects, the indicator is selected:
- **Simple properties:** Soil Organic Carbon (SOC), Soil Organic Matter (SOM), pH, Total Nitrogen (N), available Phosphorus (P), soil texture (clay, silt, sand), bulk density, Electrical Conductivity (EC), heavy metals (concentration)
- **Complex (derived) properties:** available water capacity, erosion, salinity, soil respiration, earthworms, soil biodiversity (can contain soil respiration and earthworms but not necessarily), soil sealing, soil contamination, compaction
- These 18 soil indicators have been evaluated against:

- The NextSpace Copernicus User requirements for soil in 2019 (8/19)

- EJP SOIL-SIREN (12/14)

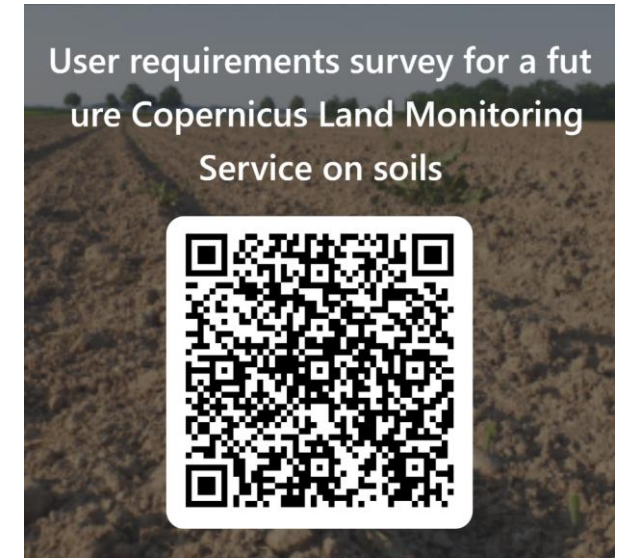
- Mission ‘A Soil Deal for Europe’ (8/13)

- Proposed EU Soil Monitoring Directive (16/18)

	NextSpace Copernicus User Requirements (Soils) 2019 https://www.copernicus.eu/en/documentation/studies-and-surveys	Shortlist "minimum dataset" suggested by EJP/SIREN project	A soil deal for Europe - Implementation plan 202x	Soil Health Law July 2023	BENCHMARKS/A4S/SoilHealth
	Latest known Copernicus user requirement study	The EJP SOIL program is the scientific forefront in Europe dealing with a sustainable European integrated research system and develop and deploy a reference framework on climate-smart, sustainable agricultural soil management. This is a reduced list based on an extensive review of literature, EU policies, requirements from member states and EU projects.	Implementation plan of the EC to achieve 100% healthy soils in 2050	Legal framework for the development of healthy soils.	The project aims at providing a clear soil health index for benchmarking, using indicators that are pertinent to the objective of assessment, applicable to the land use and logistically feasible.
Reason for selection:					
Soil health indicators/parameters (24) from the currently running soil projects	Soil Feasibility Soil Carbon Content Soil Surface Visual Roughness Climatological Maps Land Use/cover Topography Soil Moisture Soil erosion risk maps Soil erosion change risk maps Vegetation condition factor Soil types - Landcover map Vulnerability Soil Moisture (SM) Soil carbon emissions and removal Soil Fertility Soil Degradation Soil Nutrient Content Soil Sealing Impedance Soil Moisture Map - Animals Soil Temperature	Texture Priority Bulk density C concentration Total N Total P K pH Erosion Clay Heavy metals Other contaminants Soil biodiversity Water respiration Presence of pathogens Insect numbers Soil Soil organic carbon stock Soil structure Bulk density Soil sealing erosion Soil biodiversity Soil nutrients and acidity (pH) Vegetation cover Landscape heterogeneity Forest cover	Soil Nutrient Availability Extractable P Bulk density available water capacity erosion Salinization electrical conductivity Soil basal respiration Loss of soil biodiversity Total artificial land Land take Soil Sealing heavy metals Soil contamination Compaction		
Simple properties					
SOM					
SOC	x		x		
pH	x			x	
Total N	x		x		
P available	x		x		
Texture	x				
Bulk density		x		x	
EC					
heavy metals					x
Complex or derived properties					
available water capacity					x
erosion	x				x
salinity	x				x
Soil respiration	x				x
Earthworms					
Soil Biodiversity			x		x
Soil Sealing					x
Soil contamination			x		
Compaction					x

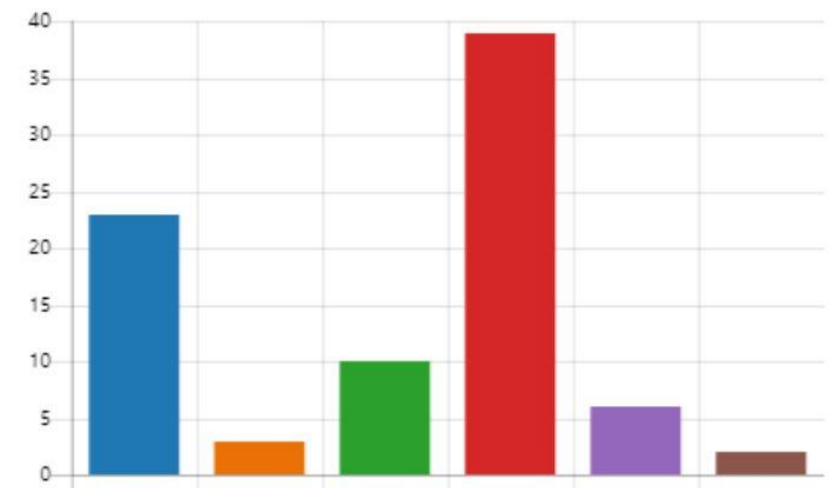
User Survey - Development

- A survey was launched to understand more about the specifications of the spatial information
- 23 questions
- Sent out to people across Europe on soils and EO in 2023/2024
- Results presented here and in report
- **83 responses**
- Majority of participants from Europe, also some from all other continents



2. What best describes your organization?

National government	23
European / international orga...	3
Business	10
Research	39
Education	6
NGO	2

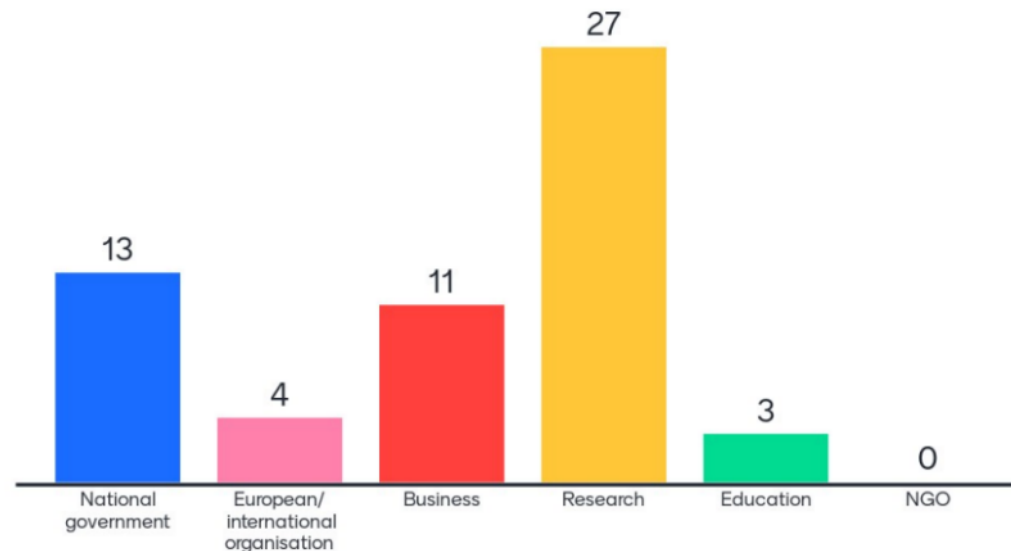


User Requirement Meeting

- 2 hour workshop on 7 December 2023
- 148 registered participants - **80 real participants**
- Partitioning across sectors is quite similar in 3 sources: researchers and public sector, followed by business

Mentimeter

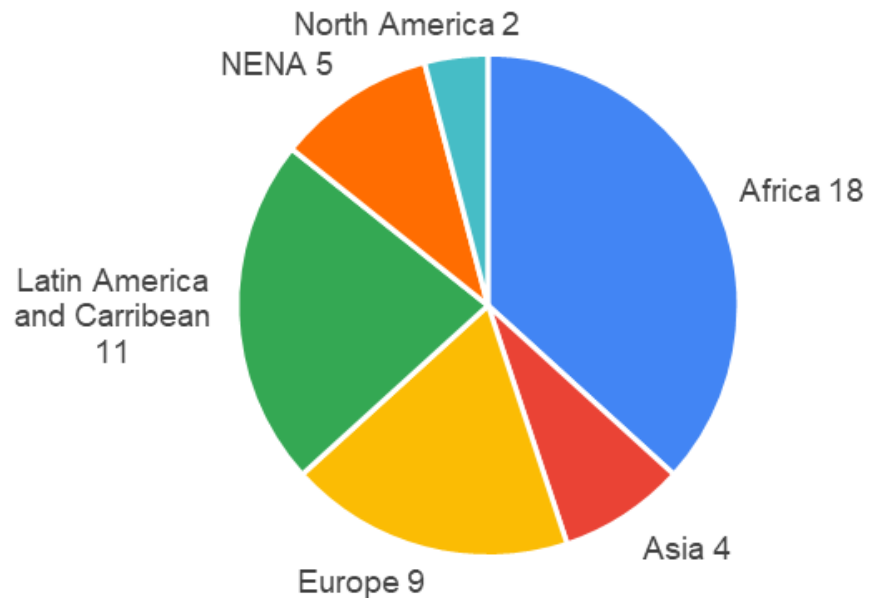
What best describes your organisation?



Survey within INSII on needs and arguments for soil information, mapping, monitoring

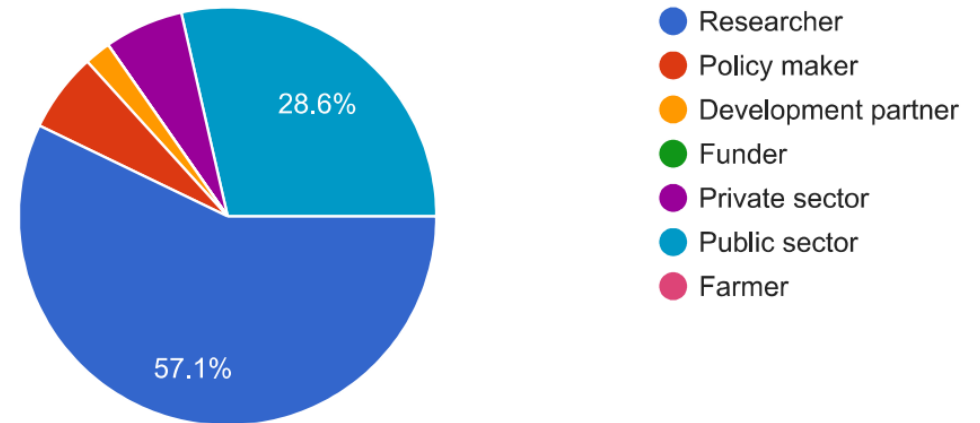
49 responses from 35 countries

Nr of responses per continent



What is your role/position related to soil information activities?

49 responses



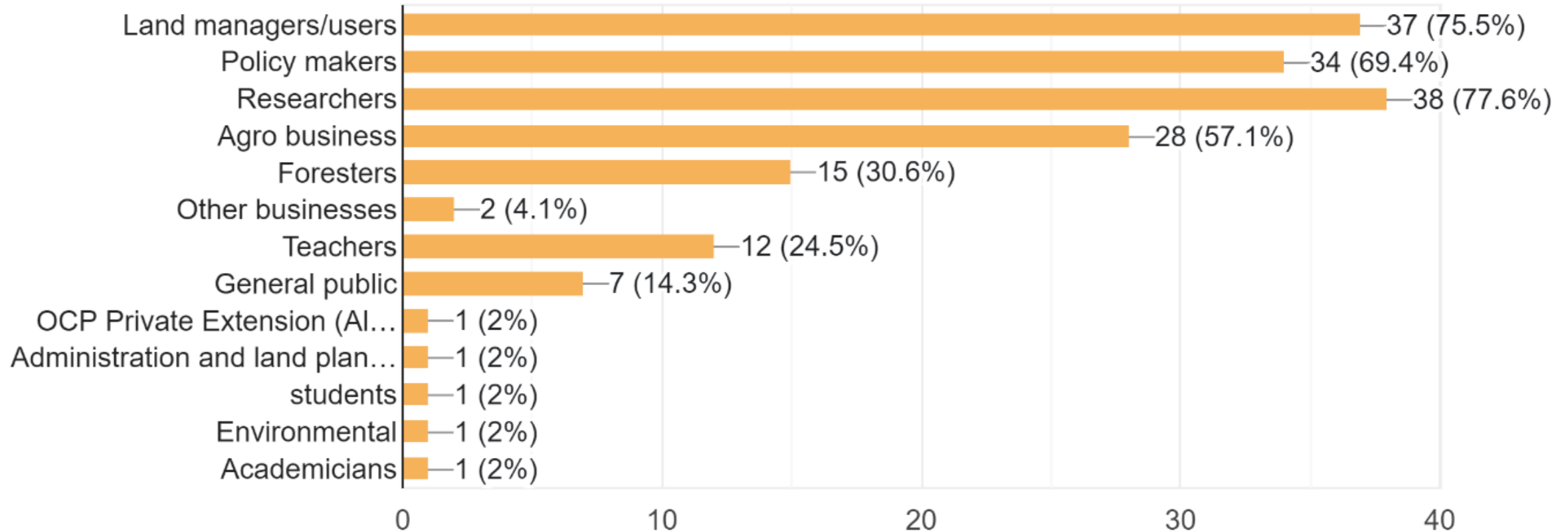
10th Meeting of the International Network of Soil Information Institutions (INSII) | 15-16-17 January 2025



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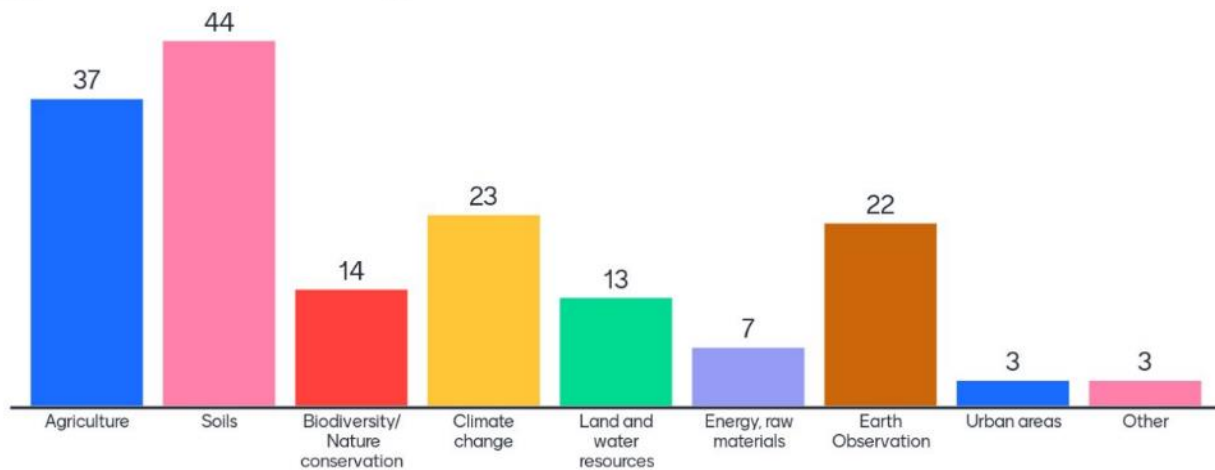
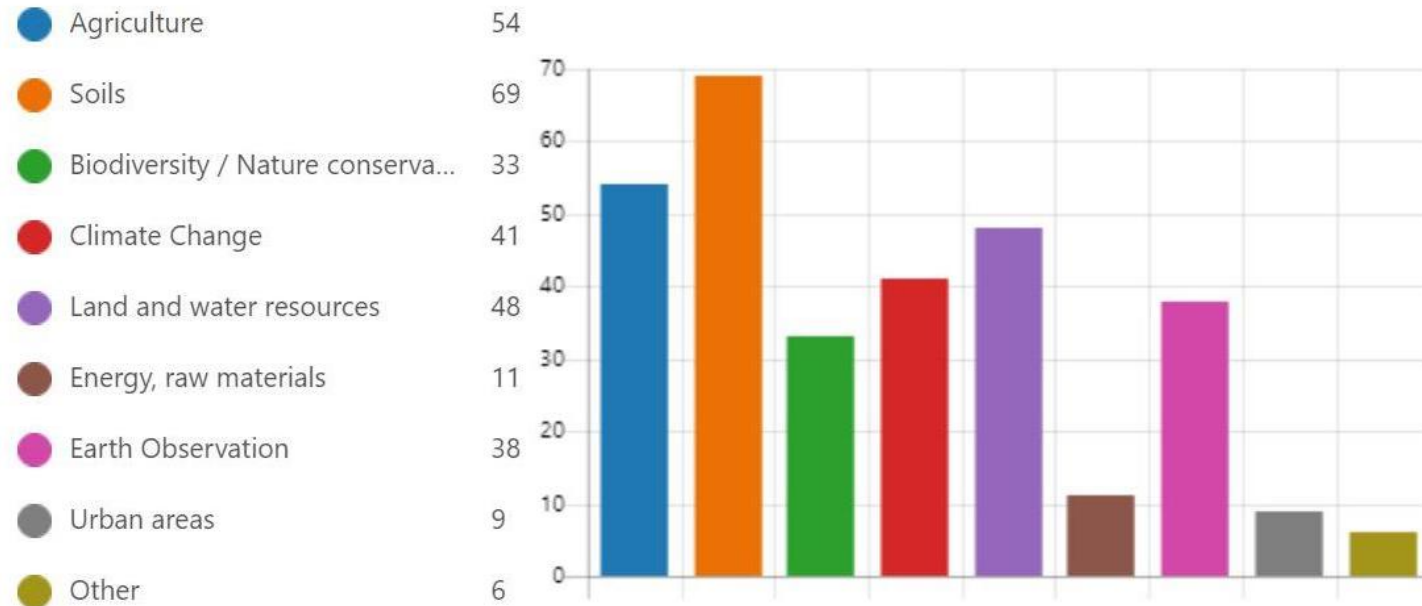
Who are the main users of the soil information in your country?



49 responses, 35 countries

User Survey – Workshop – INSII survey

What are the main topics your organisation is working on?



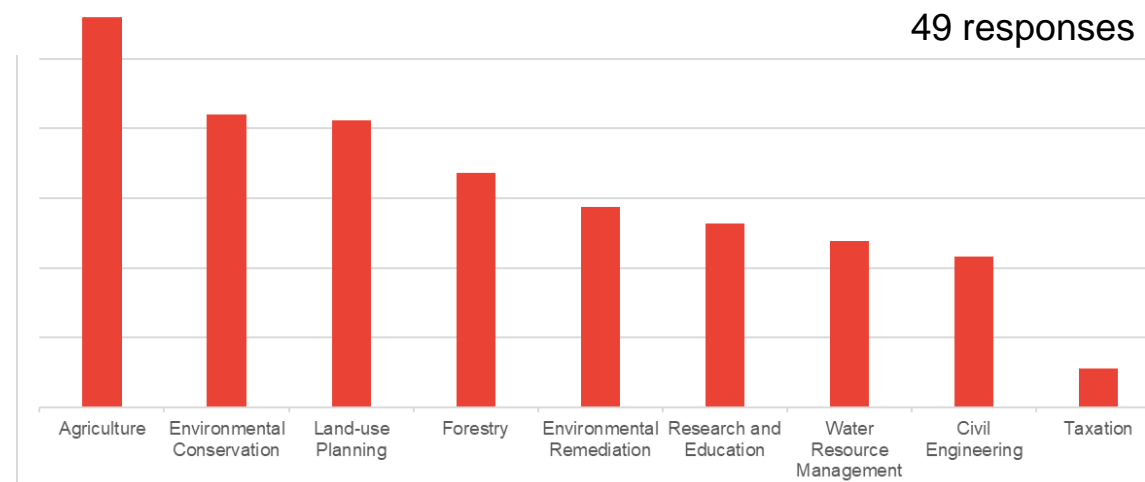
Agriculture

Soils

Climate change/EO/land and water resources/

Environmental conservation/Land use planning/
Forestry

Frequency of main current applications of soil information

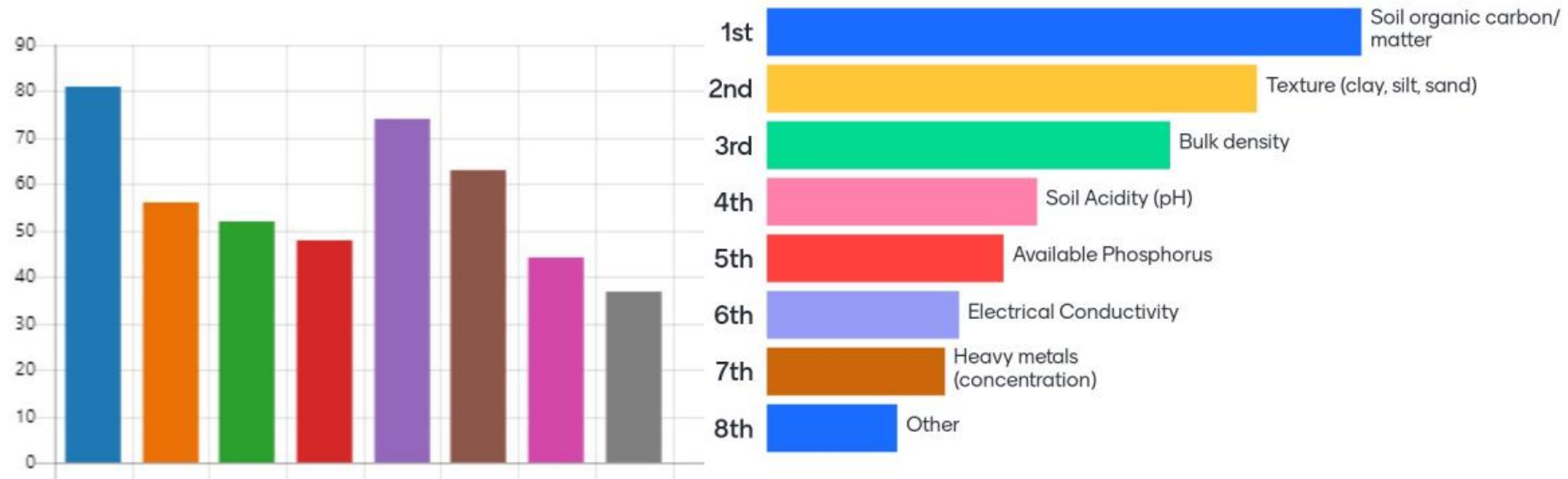


CUP4SOIL – User Requirement Study

User Survey – Workshop

Which soil-related spatial information would be helpful for your work (basic soil properties)?

Soil organic carbon / Soil orga...	81
Soil acidity (pH)	56
Total Nitrogen	52
Phosphorus available	48
Texture (clay, silt, sand content)	74
Bulk density	63
Electrical Conductivity (EC)	44
Heavy metals (concentration)	37
None of them	0

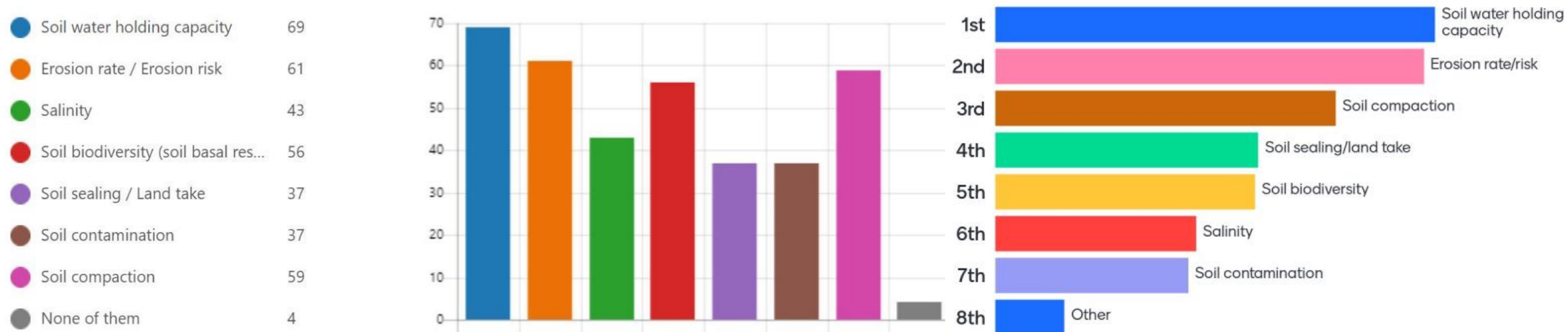


Same prioritization: SOC, texture, bulk density, pH, , (N), P, EC, heavy metals

CUP4SOIL – User Requirement Study

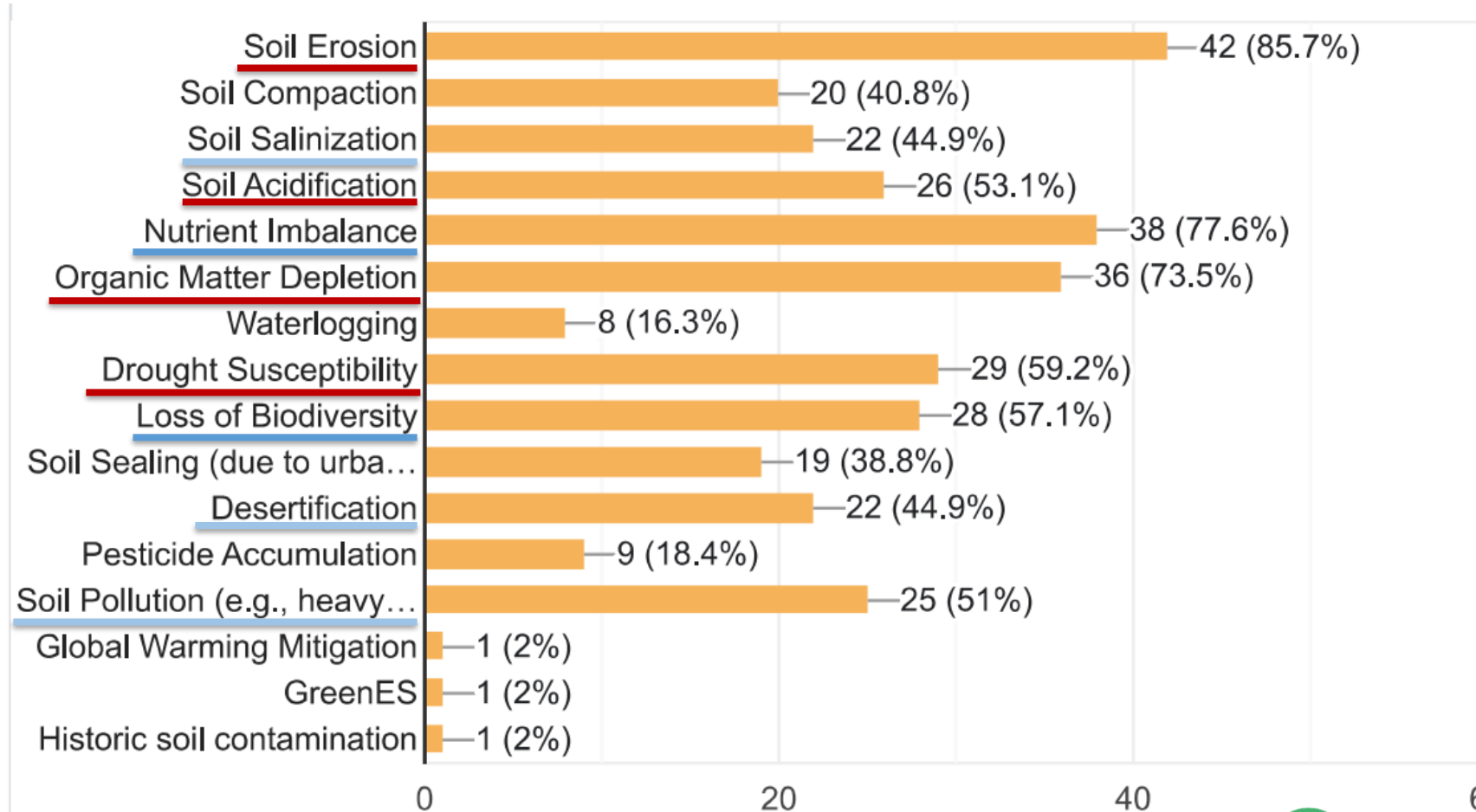
User Survey – Workshop

Which soil-related spatial information would be helpful for your work (derived/complex properties)?



Same top three: Soil water holding capacity, erosion rate/risk, soil compaction

Please identify the main soil issues or challenges currently faced in your country



49 responses

How do these challenges impact the need for and use of soil information?

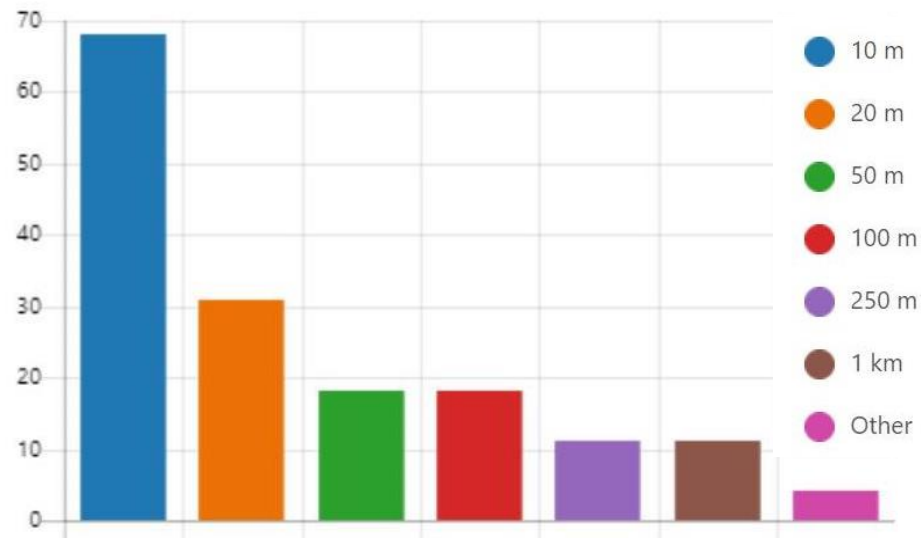
- Detailed, accurate, reliable and up to date soil information, monitoring, SIS/database needed to deliver information for well informed decision making

soil fertility, (sustainable) soil management practices (irrigation, fertilisation, pest management, crop selection), land use planning, combating soil degradation, desertification, soil health depletion, erosion risk, pollution, GHG emissions, OM depletion, nutrient imbalances, drought susceptibility, salinisation, regulation of use of natural resources, soil sealing, soil compaction.

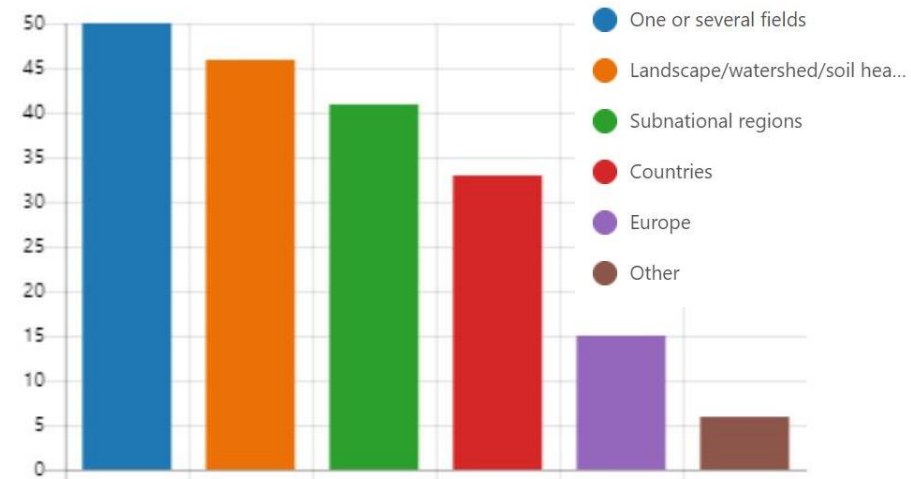
- For policy makers, farmers, DST systems
- You manage what you know
- First assess, then define strategy and act
- Need to collate existing information (often old or local) to identify gaps
- Needs and topics differ per country

User Survey – Resolution

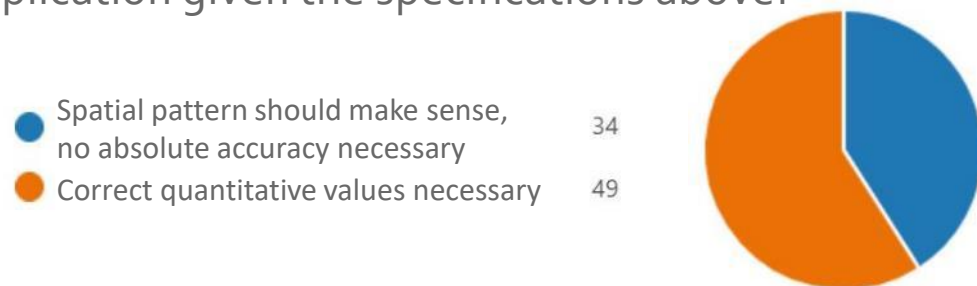
What is your preferred spatial resolution (in pixel sizes)?



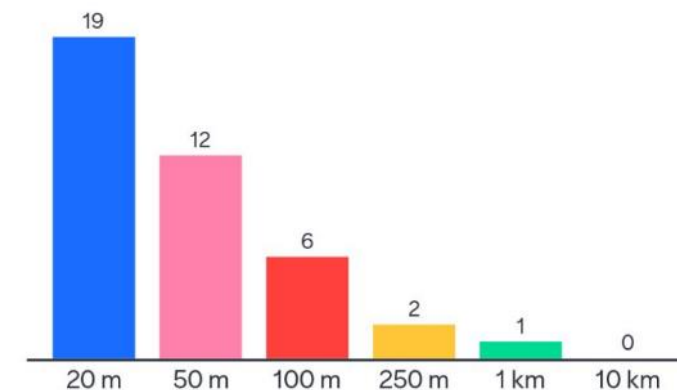
Which scale is your organisation working on?



What accuracy level is still useful/required for your application given the specifications above?

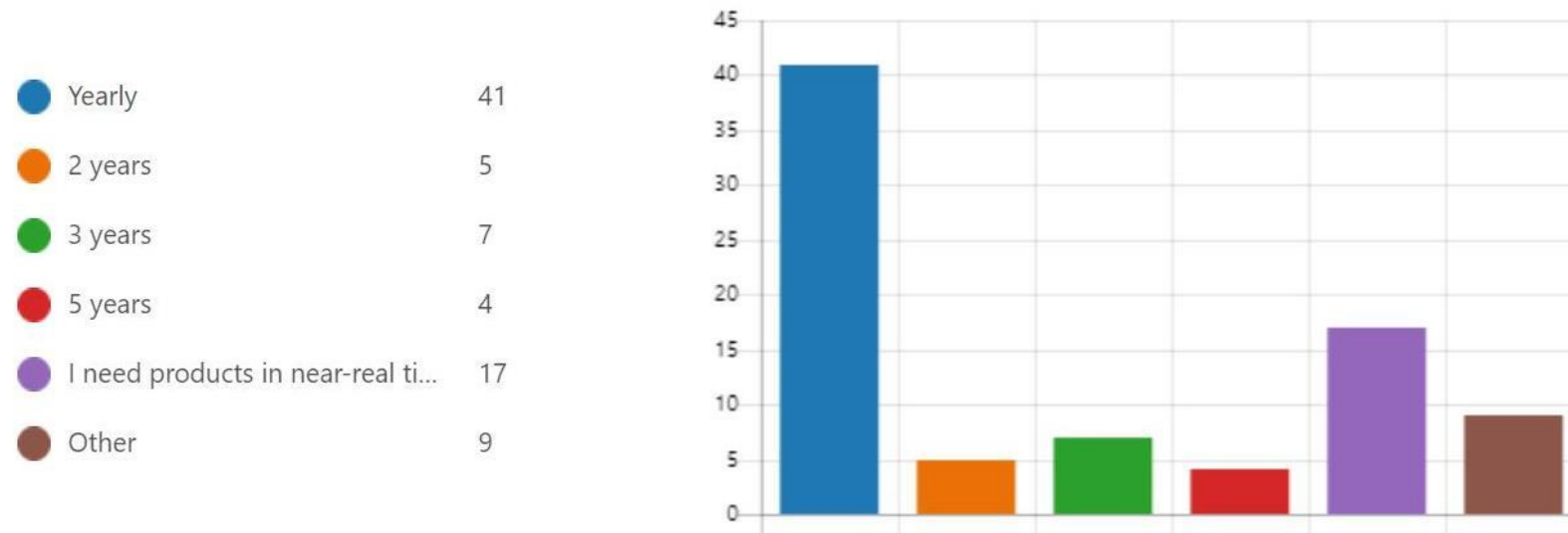


Finer resolutions are always desirable, but what are the coarsest resolutions that would still work for your use? (with accuracy matching resolution)

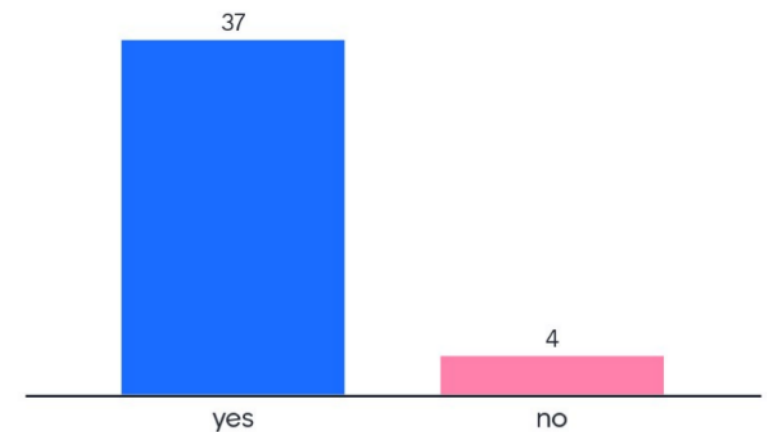


User Survey – Update frequency

How regularly would you like to get updates on the soil service products?



If it is not feasible or meaningful to make yearly or near-real time updates to the products, is a longer (5/10 years) update period still useful?



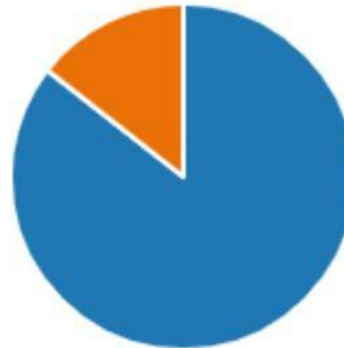
14. For which purpose do you need the soil information?



User Survey – Access and data format

20. What would be your preferred data format?

● Cloud-optimised GEOTIFF	77
● Other	13

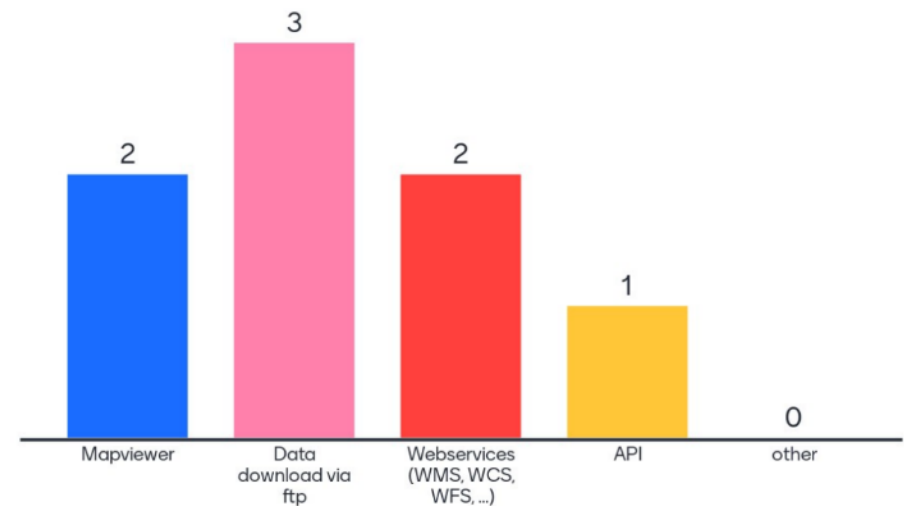


21. What would be your preferred access?

● Mapviewer	32
● Data download via ftp	46
● Webservices (WMS, WCS, WP...	43
● API	35
● Other	4

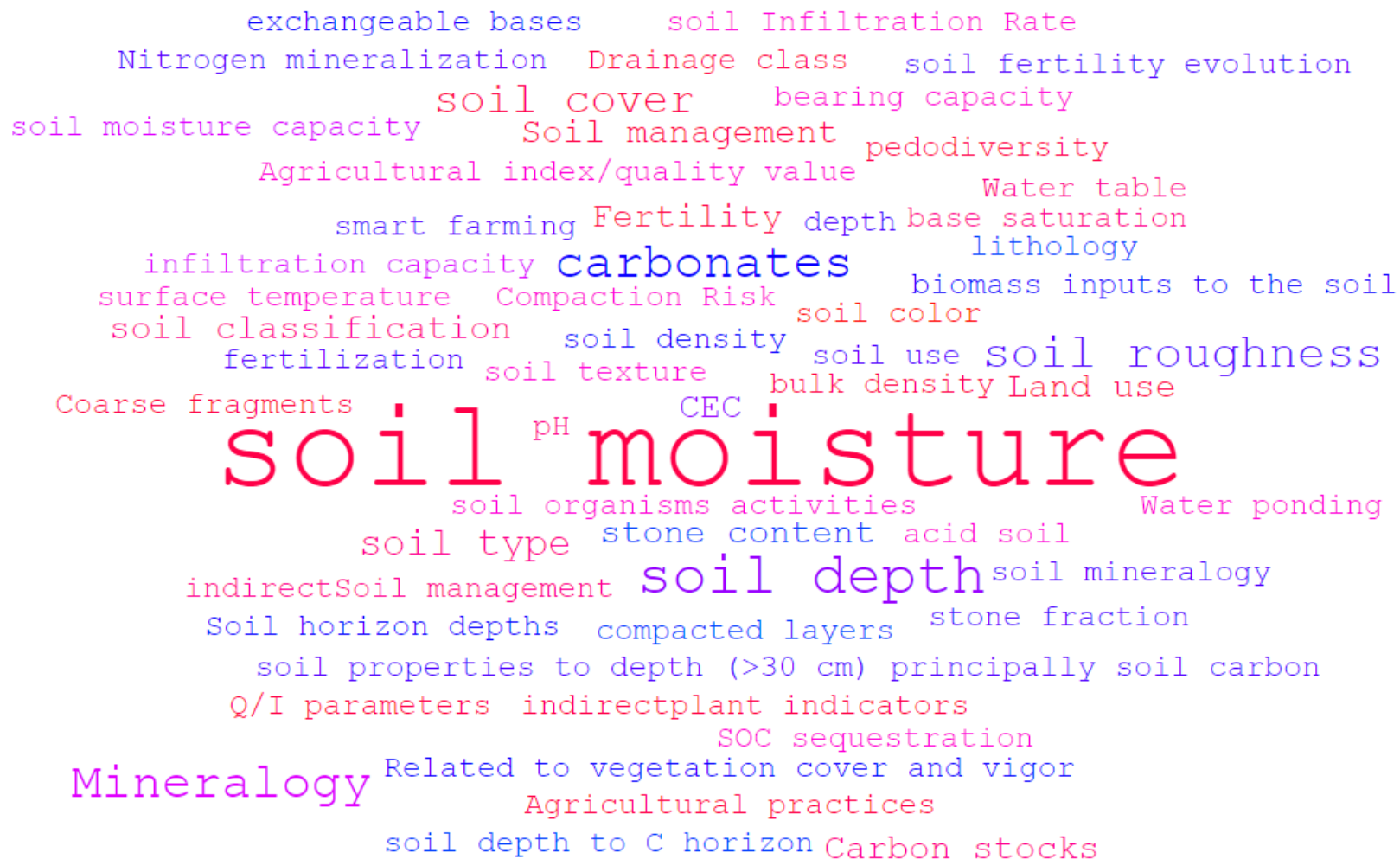


What would be your preferred access?



User Survey - Results

Which soil-related spatial information is not listed before?



User stories

As an **<actor>**,
I want to have/be able to **<function>**,
so that I can/don't have to **<business reason>**.

As a **company** that gives a economic rewards to farmers who try to increase the **carbon content**, we want to be able to track changes in the soil carbon content to **reduce sampling costs**.

As a **paying agency officer**,
I want to have soil erosion layer for **CAP compliance** at field level of 10 meter resolution.

As a **sustainable water management company**, I want to provide accurate water balance information at a parcel scale, so that farmers can manage water usage in a sustainable way for **irrigation**.

As a **government agency** we want to **evaluate our own soil** (property) **maps**. We are satisfied with a 50 m resolution (field scale).

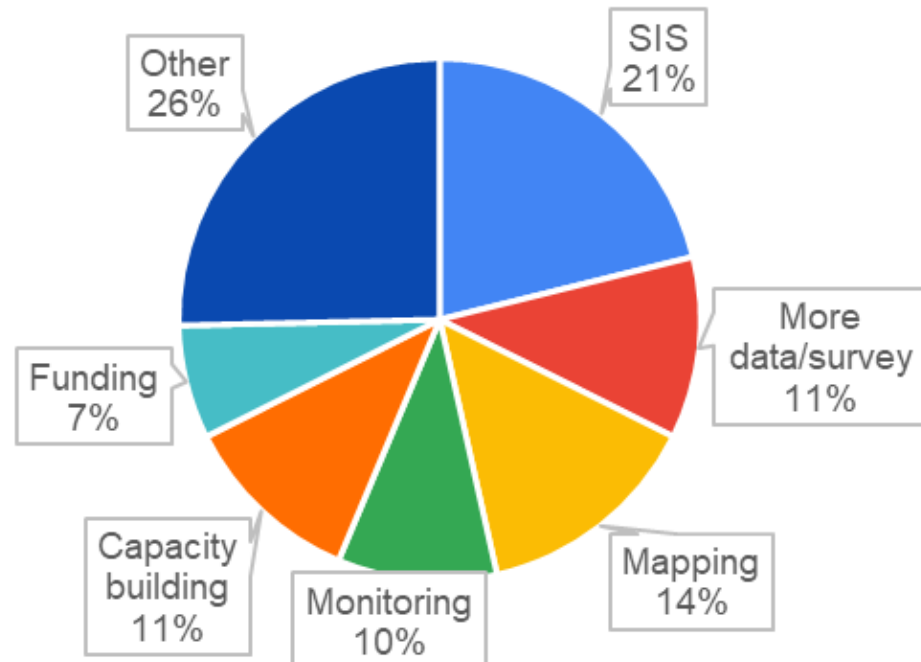
As an **ag-tech company**, I want to be able to use soil texture and SOM to generate **seeding maps**.
So, a good data layer for the farmers. I'm satisfied when the accuracy is 0.5% (SOM) at 10 m.

As a **researcher**, I want to predict SOC to be used for providing maps and plans for farmers at **regional and national level** in cooperation with governments. I'm satisfied with 20 m resolution and 10% error

The **resolution** is not so much the question, the question is how valid, how **accurate** is the model.

What next step is most needed in your country for soil information, SIS, soil monitoring, and mapping?

What next step is most needed in your country for soil information?



SIS: (further) development or maintenance, incl. data standardisation and harmonisation.

Maps: update maps, make more detailed or other maps.

Monitoring: incl. specifically peat or erosion.

Capacity building: on various topics, incl. of stakeholders.

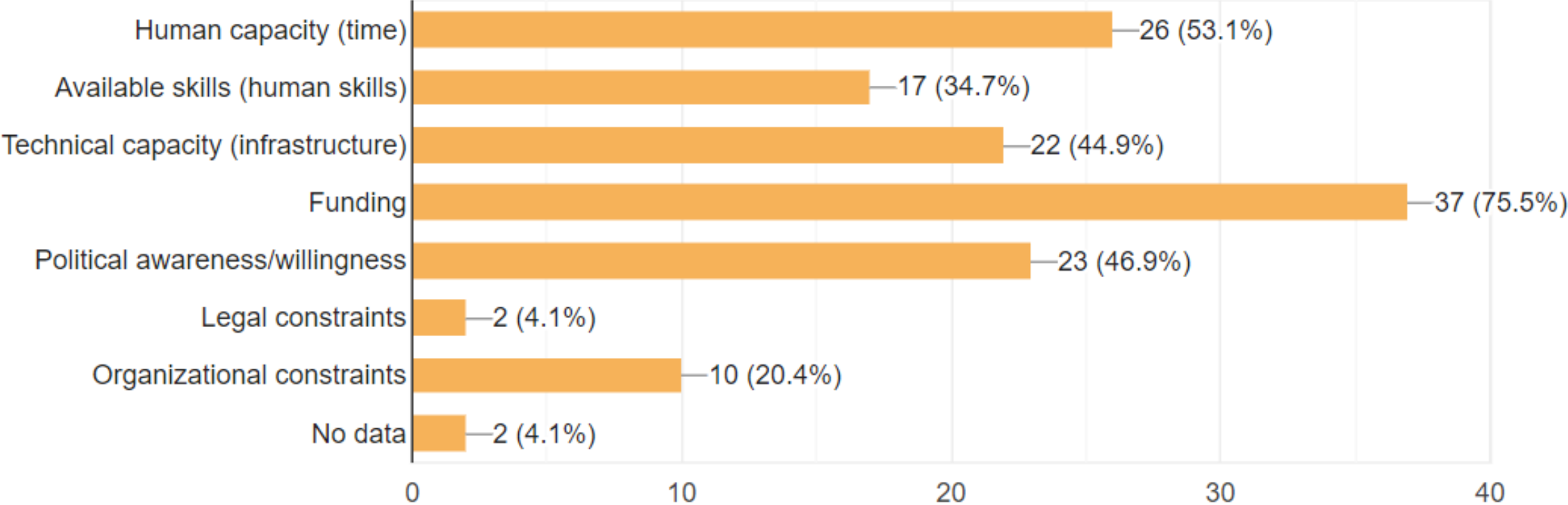
Funding: institutionalise, long term.

Other needs: soil health or quality maps/data, providing the data in an accessible and understandable way, awareness raising, legislation, integration or collaboration between different state actors, public/private collaboration, long-term national vision on soils, rebuilding of facilities due to war.

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What are your biggest challenges/concerns in setting up a Soil information system/Monitoring program/Mapping?



49 responses

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Follow up research on user requirements – some ideas

- More detailed information per soil property:
 - For which applications is the map used?
 - Who are the stakeholders concerned?
- Per application:
 - Which resolution is needed?
 - Which frequency and integrated time period is needed/still useful?
 - Which accuracy is needed/which inaccuracy is still useful?
 - What is the added value of the higher resolution/accuracy maps (in euro's and innovation/application opportunities)?
- What else is needed to make these maps useful? (e.g. documentation, license, format, coordinate system, guidance material, comparisons with other maps, etc.)
- How to handle data privacy with higher resolutions?
- What is needed to use these maps for more purposes?

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Thank you very much!

User requirements report will be published on the website

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