alpenkonvention • convention alpine
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Soil Protection Working Group

Questionnaire permanent monitoring sites

Content by country in alphabetical order

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Soil Protection Working Group

Questionnaire permanent monitoring sites

Please send your feedback ***by FR, 13.09.2019*** *to vera.bornemann@alpconv.org to allow us to prepare an overview of the results for the 2nd meeting of the working group.*
When filling out this document, please do not use footnotes. If you would like to make comments, use the Comments section at the end. Please delete this instruction text and the other instructions in the document. Just keep the answers. Please copy the questionnaire as many times as needed starting with a new page for every monitoring scheme, or use separate document for every monitoring scheme you will send in.

AT – LTER Zöbelboden

National Name: Erhebungen zur langfristigen Ökosystem-Beobachtung, Zöbelboden

1. Brief description of the instrument

The Zöbelboden was established in 1992 as the only Integrated Monitoring station in Austria under the UN Convention on long-range transboundary air pollution (CLRTAP). In 2006 it became part of LTER Austria. The Zöbelboden covers a small forested catchment (90 ha) of a karstic mountain range (500 to 950 m above sea level) in the Kalkalpen national park. Monitoring and research is focussing on air pollution effects on forested catchments and its interaction with climate change. The Zöbelboden represents one of the best known karst catchments in Europe with long-term data series of the major components of its ecosystems. The Zöbelboden is managed by the Umweltbundesamt GmbH. Sampling of chemical specimen is done by local staff. Chemical analyses are carried out by the laboratory of the Umweltbundesamt in Vienna (https://deims.org/8eda49e9-1f4e-4f3e-b58e-e0bb25dc32a6).

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Umweltbundesamt GmbH www.umweltbundesamt.at

3. Type of instrument

- international monitoring systems,
- national monitoring systems,

- instrument with direct impact on soil.

4. Status of policy instrument

- In place (1989),

5. Territorial coverage

- international,

6. Sectoral coverage

- forestry,

7. Soil threats addressed by instrument

- contamination,
- loss of soil biodiversity,

8. Soil functions addressed by instrument

- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

- forests,

10. Monitoring sites

GIS layer to be found here: https://deims.org/8eda49e9-1f4e-4f3e-b58e-e0bb25dc32a6

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
  - Organic compounds
- Soil carbon
- Soil biodiversity
- Climate parameters
  - Soil temperature
  - Soil water content

12. Data availability

The data is or will soon be available without any restrictions here:
https://deims.org/8eda49e9-1f4e-4f3e-b58e-e0bb25dc32a6

13. Monitoring mechanisms

LTER Zöbelboden is a small, well definable catchment of 90 ha in the National Park Kalkalpen in Austria. Material inputs, pollutants and nutrients via air and precipitation are measured as well as their effects on the ecosystem. Their behaviour within the ecosystem is studied in a comprehensive manner and effects are determined. With standardized methods the long-term trends of ecosystem water and element fluxes are studied. Outputs through surface waters and into groundwater are part of this work as are trends in biodiversity and effects of climate change. The the long-term data is used in the UNECE CLRTAP effects monitoring networks, in EMEP, and the national air pollution monitoring. LTER Zöbelboden is an important site within the Austrian LTER network so that many research institutions use the site in their projects.

Meteorological and air pollution monitoring is carried out at a clearing area (EMEP station; includes measurement of fog deposition) and on a tower (45 m height). Three intensive plots exist for the detailed measurement of element fluxes through the main forest types (bi-weekly to monthly analyses of deposition and soil water). Catchment runoff chemistry is measured at the main spring with a measuring weir (weekly analyses) and through irregular sampling at all other springs. Additional karst-hydrological measurements are in place in the main rivers surrounding the mountain range. On 64 permanent plots (regular 100 m grid) forest tree monitoring, ground vegetation and soil sampling is carried out (5 to 10 year interval). Additional permanent plots exist for forest floor vegetation, lichens, bryophytes and birds (3 to 10 year interval). The main stations (EMEP station, intensive plots, the hut) can be reached via a forest road with all year access (once a week in winter).The station has full power supply, a radio transfer of the data within the site and remote online access to the major devices.

For a full parameter list please go to **https://deims.org/8eda49e9-1f4e-4f3e-b58e-e0bb25dc32a6**

14. Other available information

Integrated Monitoring Manual: **https://www.syke.fi/en-US/Research__Development/Ecosystem_services/Monitoring/Integrated_Monitoring/Manual_for_Integrated_Monitoring**

Auswertung der Bodeninventurdaten Zöbelboden:
https://www.umweltbundesamt.at/umweltsituation/oekosystemareumweltkontrolle/oekosystem_monitoring/ergebnisse_lter/bodenchemie/

Comments by the assessor:

AT –Agricultural soil protection program of Styria

National Name: Steiermärkisches landwirtschaftliches Bodenschutzprogramm.

1. Brief description of the instrument

Das Steiermärkische landwirtschaftliche Bodenschutzgesetz (LGBl. Nr. 66/1987) und die Bodenschutzprogrammverordnung (LGBl. Nr. 87/1987) sehen vor, dass in der Steiermark zur Beurteilung des durch Schadstoffeintrag, Erosion und Verdichtung gegebenen Belastungsgrades landwirtschaftlicher Böden ein geeignetes ständiges Netz von Untersuchungsstellen geschaffen und dort laufend Zustandskontrollen durchgeführt werden.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Amt der Steiermärkischen Landesregierung, A10, Referat Boden- und Pflanzenanalytik

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

- since 1986

5. Territorial coverage

- regional (federal state),

6. Sectoral coverage

- agriculture,

7. Soil threats addressed by instrument

- erosion,
- loss of soil organic matter,
- contamination,
- compaction,

8. Soil functions addressed by instrument

- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- agricultural areas,

10. Monitoring sites

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
  - Organic compounds
- Soil carbon
- Soil erosion

12. Data availability

Daten im LUIS (Landesumweltinformationsystem) bzw. GIS einsehbar.

13. Monitoring mechanisms

- Vollzug des Steiermärkischen Bodenschutzgesetzes und der anhängenden Bodenschutzprogrammverordnung.

14. Other available information

Bodenschutzberichte

Comments by the assessor: -

AT –- (permanent) soil monitoring Salzburg

National Name: Bodendauerbeobachtung (BDF) Salzburg

1. Brief description of the instrument

The Salzburg Soil Protection Act provides for the establishment of soil observation areas in § 15. The overarching goals of soil monitoring are for example: Recording the current properties and loads of selected soils as a continuation of the soil inventory, Long-term determination of soil changes, Derivation of the sensitivity of soils to different factors, Comparative assessment (pollution and clean air area).
8 monitoring areas have been set up since 1996.
The scope includes anorganic and organic parameters and pollutants, soil physical and soil biological parameters and radionuclides

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Government of the Land Salzburg
https://www.salzburg.gv.at/themen/aw/landwirtschaft/boden

3. Type of instrument

- regional monitoring systems,
- instrument with direct impact on soil.

4. Status of policy instrument

- In place since 1996

5. Territorial coverage

- regional (federal state or non-federal state),

6. Sectoral coverage

- agriculture

7. Soil threats addressed by instrument

- loss of soil organic matter,
- contamination,
- compaction,
- loss of soil biodiversity,

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,

- acting as carbon pool,

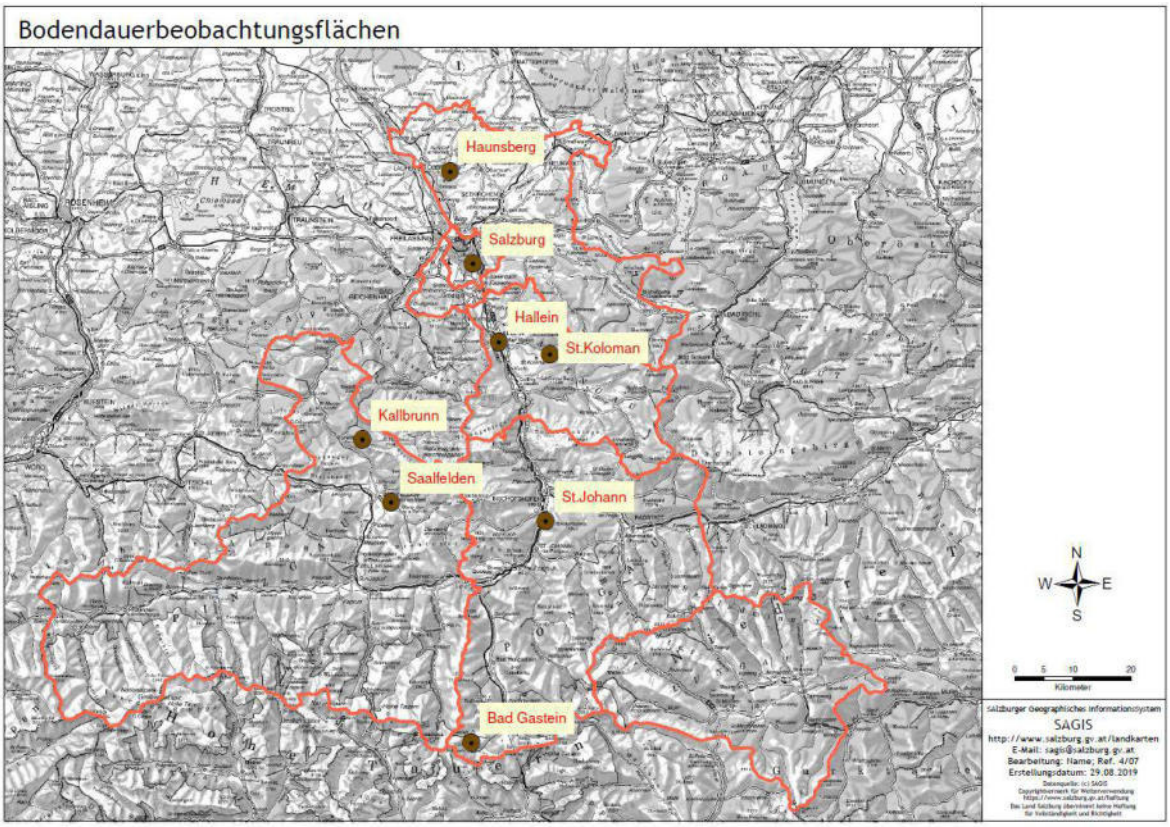
9. Land cover classes addressed by the instrument

- agricultural areas,
- semi-natural areas,

10. Monitoring sites

Please list here the monitoring sites, which are in the perimeter of the Alpine Convention. List the locations, site characteristics and other relevant information as exact as possible in writing. Please include cartographic overview(s), if available.

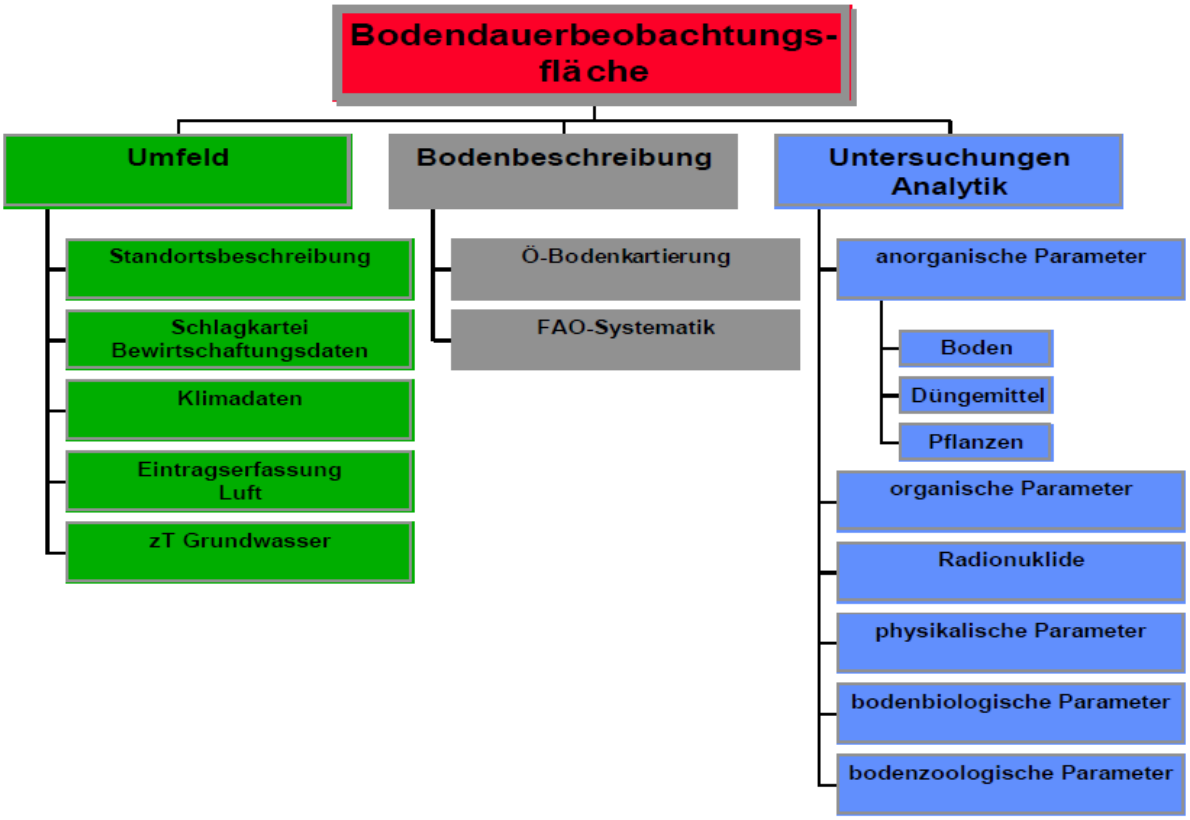
❶ Hallein (Wechselgrünland, kalkhaltiger grauer Auboden, Industriestandort)
❷ St. Koloman (Grünland, Braunlehm, Hintergrund)
❸ Saalfelden (Grünland, entkalkte Lockersediment-Braunerde, Hintergrund)
❹ Salzburg Stadt (Acker, kalkhaltiger grauer Auboden, städtisches Gebiet)
❺ St. Johann (Grünland, kalkfreie Lockersediment-Braunerde, Vorbelastung Bergbau)
❻ Weißbach/Kallbrunnalm (Almfläche kalkalpin, stark versauert)
❼ Nußdorf/Haunsberg (Grünland, Lockersedimentbraunerde, Staulage)
❽ Bad Gastein (Almfläche, zentralalpin, Vorbelastung Bergbau)



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry

    - pH-value
    - Heavy metal concentrations
    - Organic compounds
- Soil carbon
- Soil biodiversity
- Climate parameters



12. Data availability

data are restricted, meta-information available, INSPIRE yes

13. Monitoring mechanisms

13. Other available information

https://www.salzburg.gv.at/agrarwald_/Documents/bodenschutzbericht_endversion_fuer_internet.pdf page 34 – 42

Comments by the assessor:

AT –- (permanent) soil monitoring Salzburg

National Name: Monitoring Bodenverbrauch Salzburg

1. Brief description of the instrument

To minimize the land consumption is in Salzburg is of great public and political interest, because the area of permanent settlement is only about 20 %.

In 2019 has set up a project to establish the real land consumption in Salzburg. The basis for the project are satellite pictures and special evaluation methods. After the basic surveys is the plan to repeat the evaluation every five or ten years to show the change process and to take measures for reducing land consumption. The decision about the repeat is not yet decided.

The first statistical evaluations are expected in spring 2020.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Government of the Land Salzburg
https://www.salzburg.gv.at/themen/aw/landwirtschaft/boden

3. Type of instrument

- regional monitoring systems

4. Status of policy instrument

- in pipeline

5. Territorial coverage

- regional (federal state or non-federal state),

6. Sectoral coverage

- cross sectoral

7. Soil threats addressed by instrument

- soil sealing

8. Soil functions addressed by instrument

- platform for human activity

9. Land cover classes addressed by the instrument

- artificial surfaces
- agricultural areas
- forests

10. Monitoring sites

The project starts in 2019 and there are any results yet. The plan is, to realize the project for all areas in Salzburg.

11. Parameter groups

- Site characteristics

12. Data availability

The plan is, that meta-information is available and it should be in line with inspire.

13. Monitoring mechanisms

13. Other available information

Comments by the assessor:

AT –- Soil inventory Salzburg

National Name: Bodenzustandsinventur (BZI) Salzburg

1. Brief description of the instrument

The aim of the soil inventory is (was) the detection and assessment of the soil condition, especially with regard to heavy metal pollution.

The investigations were based on the Austria-wide recommendation of the Austrian Soil Science Society.

462 monitoring points in a 4 x 4 km grid have been set in the year 1988 to 1990.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Government of the land Salzburg
https://www.salzburg.gv.at/themen/aw/landwirtschaft/boden

3. Type of instrument

- national monitoring system
- regional monitoring systems,
- instrument with direct impact on soil.

4. Status of policy instrument

- In place since 1988

5. Territorial coverage

- regional (federal state or non-federal state),

6. Sectoral coverage

- agriculture
- forestry

7. Soil threats addressed by instrument

- loss of soil organic matter,
- contamination,

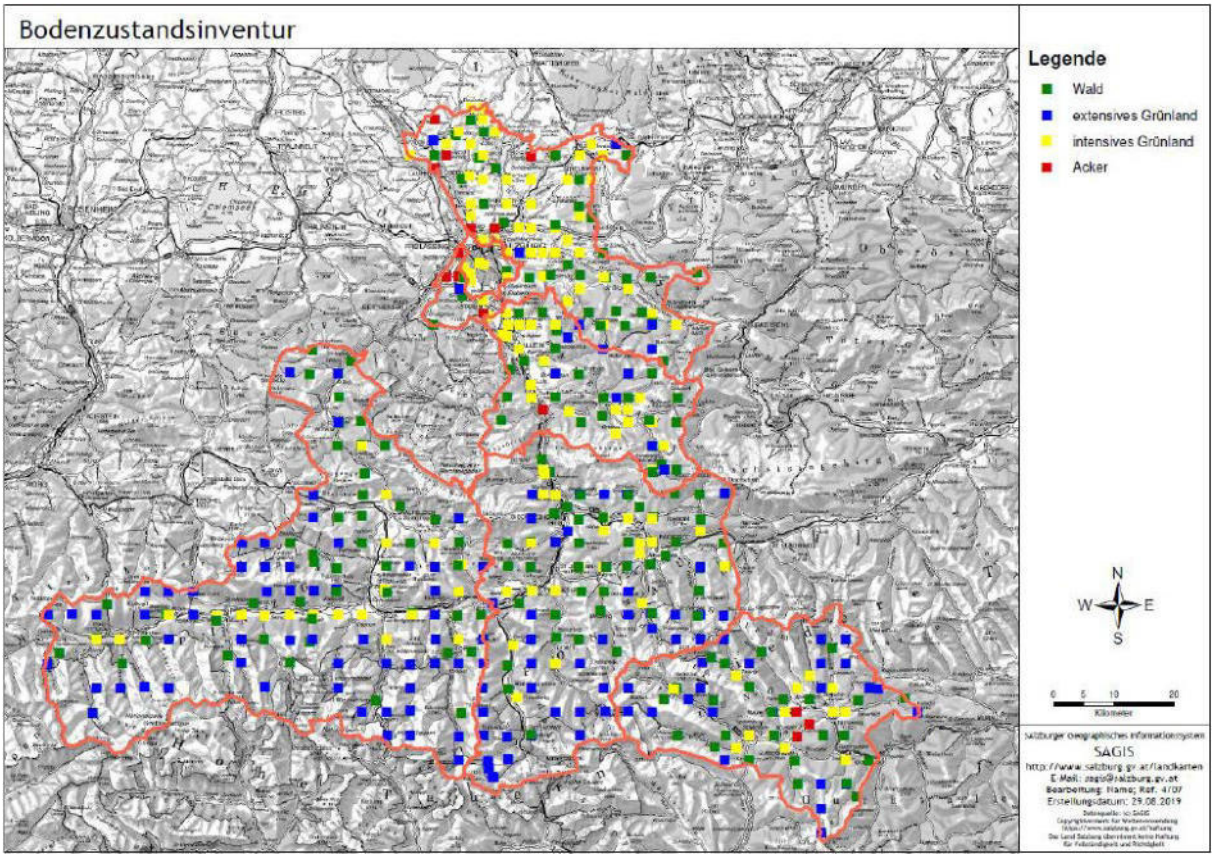
8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

- agricultural areas,
- semi-natural areas,
- forests,

10. Monitoring sites



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
  - Organic compounds
- Soil carbon

12. Data availability

data are free available, meta-information available, INSPIRE yes

https://www.salzburg.gv.at/sagisonline_boden

13. Monitoring mechanisms

14. Other available information

https://www.salzburg.gv.at/agrarwald_/Documents/bodenschutzbericht_endversion_fuer_internet.pdf page 34 – 42

Comments by the assessor:

AT – Permanent Soil Monitoring Program of Tyrol

National Name: Bodendauerbeobachtungsprogramm für Tirol

1. Brief description of the instrument

The establishment of permanent soil observation plots serves the long-term monitoring (planned for 70 years) of soil conditions and thus a sustainable soil protection. Five sites, with one plot under agricultural and silvicultural management each, following different pollution scenarios and evenly distributed were set up. The soils are sampled and analysed every ten years to detect changing conditions and to allow taking measures for soil protection. The advantage is that targeted questions can be answered in a few informative and representative locations.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Office of the regional parliament of Tyrol, department of agricultural education, hunting and fishery AND department of forest protection

3. Type of instrument

- regional monitoring system

4. Status of policy instrument

- In place since 1998

5. Territorial coverage

- regional (federal state),

6. Sectoral coverage

- agriculture
- forestry

7. Soil threats addressed by instrument

- loss of soil organic matter
- contamination
- compaction
- loss of soil biodiversity

8. Soil functions addressed by instrument

- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- agricultural areas
- forests

10. Monitoring sites

All five sites (ten plots) are within the perimeter of the Alpine Convention.

The sites are close to the following settlements:

- Achenkirch
- Brixlegg
- Navis
- Lienz
- Reutte

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Organic compounds (dioxins, furans, PAHs, organochlorine pesticides, general pesticides)
- Soil carbon
- Soil microbiology

12. Data availability

The meta-data is soon available via BORIS (SOIL Information System in Austria https://www.umweltbundesamt.at/umweltsituation/boden/boris/boris_datenzugang/) and with some restrictions also the raw date can be accessed. Yes, it is than in line with INSPIRE.

13. Monitoring mechanisms

14. Other available information

Comments by the assessor:

AT – Soil inventory, Tyrol

National Name: Bodenzustandsinventur Tirol

1. Brief description of the instrument

The aim of the soil inventory is (was) the detection and assessment of the soil condition, especially with regard to heavy metal pollution.

The investigations were based on the Austria-wide recommendation of the Austrian Soil Science Society.

Monitoring points in a 4 x 4 km grid have been set. 658 sites were sampled 1986/1987 and 107 sites 1993.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Office of the Regional Parliament of Tyrol, department of agricultural education, hunting and fishery AND department of forest protection AND Institute of radio-chemistry of the University of Innsbruck

3. Type of instrument

- regional monitoring system

4. Status of policy instrument

- In place (reports 1988 and 1996)

5. Territorial coverage

- regional (federal state)

6. Sectoral coverage

- agriculture
- forestry

7. Soil threats addressed by instrument

- loss of soil organic matter
- contamination

8. Soil functions addressed by instrument

- no specific soil functions mentioned.

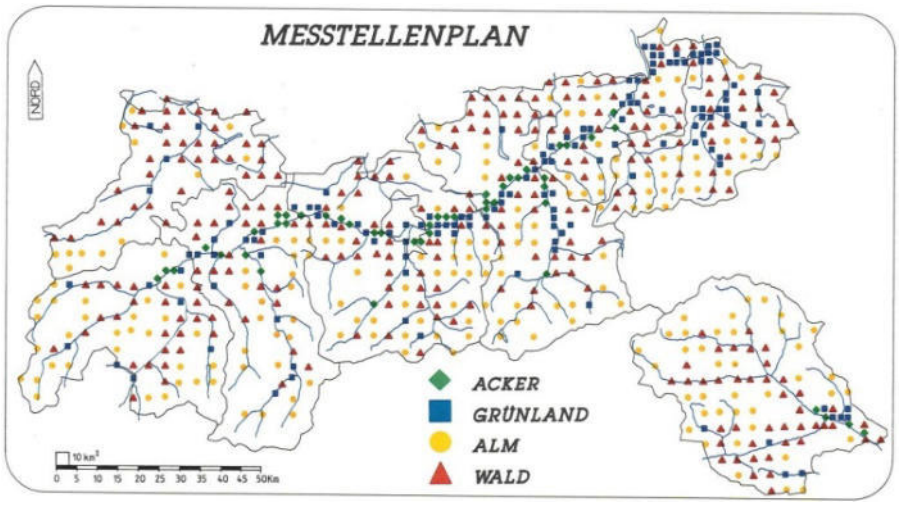
9. Land cover classes addressed by the instrument

- agricultural areas
- forests

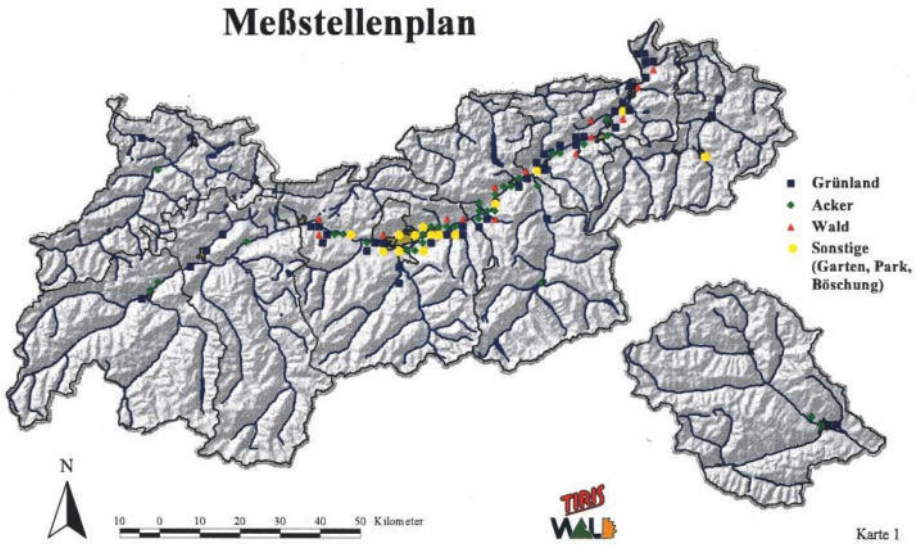
10. Monitoring sites

All sites are within the perimeter of the Alpine Convention.

263 forest, 209 alpine meadow, 139 meadow and 47 arable field sites were sampled in the years 1986 and 1987.
During the first replication 15 forest, 45 meadow, 33 arable field and 14 urban (gardens, parks...) sites were sampled in 1993.



Monitoring sites 1986/87



Monitoring sites 1993

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Nutrients
- Soil carbon
- Radio nucleids

12. Data availability

The meta-data is available via BORIS (SOIL Information System in Austria) and with some restrictions also the raw date can be accessed. Yes, it is than in line with INSPIRE.

13. Monitoring mechanisms

14. Other available information

Amt der Tiroler Landesregierung (1988): Bericht über den Zustand der Tiroler Böden. Innsbruck, 197 Seiten

Amt der Tiroler Landesregierung (1996): Bericht über den Zustand der Tiroler Böden 1996 – 1. Wiederholungsbeprobung. Innsbruck, 63 Seiten

Summary concerning forest soil is available via:
https://www.tirol.gv.at/umwelt/wald/zustand/waldboden/

Comments by the assessor:

AT – Forest Soil Monitoring

National Name: Waldbodenmonitoring

1. Brief description of the instrument

Forest monitoring in Austria has been carried out by the Austrian Research Centre for Forests (BFW) on two levels since 1988: on the one hand on monitoring plots distributed over the whole of Austria (Level I) and on the other on intensive observation areas (Level II), selected in 1995 from the Level I network.

These activities were initiated by the international cooperation program ICP-Forests of UNECE and are harmonized throughout Europe.

Currently, the BFW is continuing a slightly reduced program to ensure the preservation of the valuable time series of the intensive monitoring plots on the forest and environmental situation in Austria.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Austrian Research Centre for Forests (BFW)

3. Type of instrument

- international monitoring systems
- national monitoring systems

4. Status of policy instrument

- In place (since 1988)

5. Territorial coverage

- international,
- national (MS level)

6. Sectoral coverage

- forestry

7. Soil threats addressed by instrument

- loss of soil organic matter
- contamination
- compaction

8. Soil functions addressed by instrument

- biomass production
- storing, filtering, transforming nutrients or water
- hosting biodiversity pool
- providing raw materials
- acting as carbon pool

9. Land cover classes addressed by the instrument

- forests

10. Monitoring sites

Except sites (2) Unterpullendorf, (6) Pöggstall, (8) Dobersberg and (10) Hochburg all others are within the perimeter of the Alpine Convention.

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - nutrients
    - heavy metals
    - base saturation,cation exchange capacity
- bulk density
- Climate parameters
    - Soil temperature, Soil moisture,

12. Data availability

Selected audited Data and meta-data are available via the INSPIRE data portal. Selected climate parameters are available online via *https://bfw.ac.at/rz/bfwcms2.web?dok=8657* (Waldökodaten).

13. Monitoring mechanisms

Beside soil parameters several environmental compartments are analysed: deposition, air pollutants, needle element contents, litter, climate, tree growth.

14. Other available information

https://bfw.ac.at/rz/bfwcms.web?dok=881

https://bfw.ac.at/lims/level2.daten?kind_in=1

http://icp-forests.net/page/icp-forests-executive-report

Comments by the assessor:

AT land use and soil consumption measuring

National Name: Bericht über Widmungsbilanz und Bodenverbrauch an den Landtag

1. Brief description of the instrument

Every two years a monitoring report of the growth of building land and the loss of soil in Tyrol shall be presented to the Tiroler Landtag (provincial parliament)

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

provincial government (Tiroler Landesregierung)

3. Type of instrument

- regional monitoring system

4. Status of policy instrument

- in pipeline

5. Territorial coverage

- regional (federal state)

6. Sectoral coverage

- cross sectoral

7. Soil threats addressed by instrument

- loss of soil organic matter,
- compaction
- soil sealing
- loss of soil biodiversity,

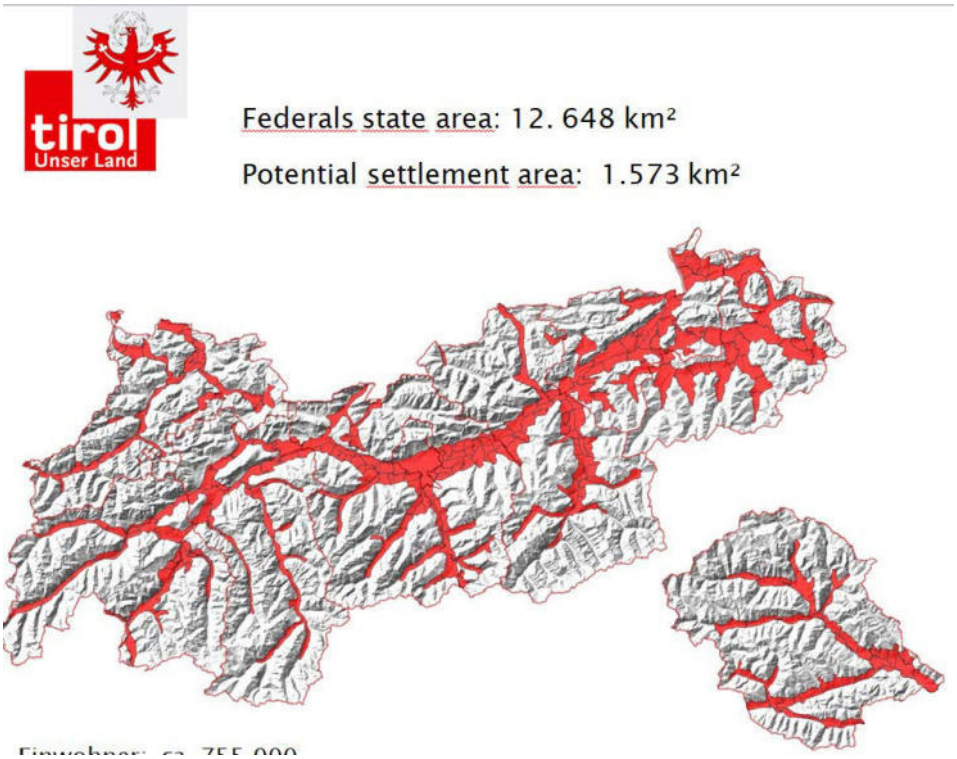
8. Soil functions addressed by instrument

- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- no specific land cover classes are mentioned/inferred.

10. Monitoring sites



area of the federal state of Tyrol, focus: Settlement area

11. Parameter groups

- Site characteristics (building and sealed area)

12. Data availability

not decided yet

13. Monitoring mechanisms

The monitoring will be based on different types of geodata (airborne and satellite remote sensing, digital land use data)

14. Other available information

-

Comments by the assessor:

The establishing of this land use and soil consumption monitoring programme is laid down in the current Tyrolean government programme 2018 – 2023.

AT-NOE – Repeated Sampling of Soil Mapping Profile Locations

National Name: Wiederholungsbeprobungen von Profilstellen der Österreichischen Bodenkartierung

1. Brief description of the instrument

Soil profile locations of the Austrian Soil Map for which archived soil material is available (about 600 locations) have been re-sampled in the period 2016-2019. The initial sampling took place between about 20-40 years ago. The instrument aims at monitoring temporal changes and the actual status of nutrients (in particular P, Si, total N), pollutants, soil acidity (pH) and organic carbon.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Universität für Bodenkultur Wien, Institute of Soil Research (www.boku.ac.at)

Agrarbezirksbehörde Niederösterreich

3. Type of instrument

- regional monitoring systems (can be potentially extended to national scale)

4. Status of policy instrument

- In place (indicate how long),

5. Territorial coverage

- regional (federal state of Lower Austria),

6. Sectoral coverage

- agriculture

7. Soil threats addressed by instrument

- loss of soil organic matter,
- salinization,
- contamination

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- providing raw materials,

- acting as carbon pool

9. Land cover classes addressed by the instrument

- agricultural areas,

10. Monitoring sites

Detailed information on the ~600 monitoring sites is currently collected and will be fully available by 2021.

11. Parameter groups

- Site characteristics (soil type and all detailed site information and soil description available from ebod)
- Soil chemistry
    - pH-value
    - Available nutrients (Si, P, K)
    - Total carbon and nitrogen
    - Lime content
    - Heavy metal concentrations (not yet but planned)
- Soil organic carbon

12. Data availability

Data will be made available upon completion of the programme in 2021.

13. Monitoring mechanisms

14. Other available information

Comments by the assessor:

AT-NOE –Expandible soil database for soil physical parameters

National Name: Bodenphysikalische Datenbank

1. Brief description of the instrument

Expandible soil database for soil physical parameters encompasses more than 1000 sites, predominantly in Lower Austria, Upper Austria and Styria. The data base includes the following parameters, e.g. pF, soil texture, organic carbon, saturated hydraulic conductivity, unsaturated hydraulic conductivity, bulk density, aggregate stability, particle density. A layer of the sites and the respective results on the website www.ebod.at or www.bodenkarte.at is in preparation.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Federal Agency for Water Management, Petzenkirchen / Bundesamt für Wasserwirtschaft

3. Type of instrument

- national monitoring systems,
- regional monitoring systems,

4. Status of policy instrument

- In place (indicate how long),

5. Territorial coverage

- national (MS level),
- regional (federal state or non-federal state),

6. Sectoral coverage

- agriculture

7. Soil threats addressed by instrument

- erosion,
- flooding landslides,
- loss of soil organic matter,
- compaction,
- loss of soil biodiversity,

8. Soil functions addressed by instrument

- biomass production,

- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- providing raw materials,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

- agricultural areas,

10. Monitoring sites

More than 1000 sites, predominantly in Lower Austria, Upper Austria and Styria. A layer of the sites and the respective results on the website www.ebod.at or www.bodenkarte.at is in preparation.

11. Parameter groups

- Soil carbon
- Soil biodiversity
- Soil erosion
- Climate parameters
    - Soil temperature

AT-NOE – Permanent Monitoring Sites

National Name: Bodendauerbeobachtungsflächen

1. Brief description of the instrument

The permanent monitoring scheme according to the methodology of Blum et al. (1996) has been implemented to monitor the initial status of soil properties with the opportunity to repeat the sampling in appropriate intervals (typically >20 years) in a statistically sound manner. Briefly, each monitoring site comprises of a square grid of 64 individual sampling points at the nods with 4 m distance between the nods. For repeated sampling the grid is shifted several times by moving the nods in both directions by 0.5 m to avoid sampling of previously disturbed soil material.
The individual samples are partitioned in 4 subsets using permutation to obtain 4 composite samples that can be analyzed separately. Data obtained can be used to calculate means and standard deviations to provide information about the plot-internal variability. This is important to evaluate significance of differences in repeated sampling over time. Sieved samples are archived.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Universität für Bodenkultur Wien, Institute of Soil Research (www.boku.ac.at)

Agrarbezirksbehörde Niederösterreich

3. Type of instrument

- national monitoring systems (as part of)
- regional monitoring systems

4. Status of policy instrument

- In place (since 1998)

5. Territorial coverage

- regional (federal state or non-federal state)

6. Sectoral coverage

- agriculture

7. Soil threats addressed by instrument

- loss of soil organic matter
- (salinization)
- contamination

8. Soil functions addressed by instrument

- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- agricultural areas

10. Monitoring sites

30 sites

11. Parameter groups

- Site characteristics (soil type)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Organic compounds
- Soil carbon
- Soil erosion

12. Data availability

Data availability is currently restricted

13. Monitoring mechanisms

14. Other available information

Comments by the assessor:

AT – NOE Hydrological Open Air Laboratory Petzenkirchen

National Name: Hydrological Open Air Laboratory Petzenkirchen

1. Brief description of the instrument

The Hydrological Open Air Laboratory (HOAL) in Petzenkirchen, Lower Austria, is a 66 ha research catchment that has been established to advance the understanding of water related flow and transport processes in the landscape, involving sediments, nutrients and microbes.
http://hoal.hydrology.at/index.php?id=2

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Federal Agency for Water Management, Petzenkirchen

3. Type of instrument

- international monitoring systems,
- national monitoring systems,
- regional monitoring systems,
- instrument with direct impact on soil.

4. Status of policy instrument

- In place (indicate how long),

5. Territorial coverage

- international,
- national (MS level),
- regional (federal state or non-federal state),
- sub-regional.

6. Sectoral coverage

- agriculture,

7. Soil threats addressed by instrument

- erosion,
- flooding landslides,
- loss of soil organic matter,
- compaction,
- loss of soil biodiversity,

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- platform for human activity,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

- agricultural areas,
- water bodies,

10. Monitoring sites

The Hydrological Open Air Laboratory (HOAL) in Petzenkirchen, Lower Austria, is a 66 ha research catchment that has been established to advance the understanding of water related flow and transport processes in the landscape, involving sediments, nutrients and microbes.
http://hoal.hydrology.at/index.php?id=2

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Organic compounds
- Soil carbon
- Soil biodiversity
- Soil erosion
- Climate parameters
    - Soil temperature

AT – Soil Inventory of Upper Austria

National Name: Bodenzustandsinventur (BZI)

1. Brief description of the instrument

The aim of the soil inventory is the detection and assessment of the soil condition.
The Upper Austrian Soil Protection Act provides for the establishment of the soil inventory.
The investigations are based on the Austria-wide recommendation of the Austrian Soil Science Society.
880 monitoring sites have been set in the years 1990 to 1993 in Upper Austria according to a defined grid. Repetition currently in progress.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Government of Upper Austria

3. Type of instrument

- regional monitoring systems,
- instrument with direct impact on soil.

4. Status of policy instrument

- In place (since 1990)

5. Territorial coverage

- regional (federal state or non-federal state)

6. Sectoral coverage

- agriculture

7. Soil threats addressed by instrument

- loss of soil organic matter,
- contamination,

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

- agricultural areas
- semi-natural areas

10. Monitoring sites

The monitoring sites located in the Southern districts of Upper Austria are partly within the perimeter of the Alpine Convention.

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Organic compounds
- Soil carbon

12. Data availability

Data available in the BORIS Soil Information System for Austria. INSPIRE: yes.

https://www.umweltbundesamt.at/boris

13. Monitoring mechanisms

14. Other available information

www.land-oberoesterreich.gv.at

Comments by the assessor:

AT, IT, CH – Comparative, long-term ecosystem monitoring across the Alps: Austrian Hohe Tauern National Park, South-Tyrol and the Swiss central Alps

National Name: Interdisziplinäres, integratives Monitoring- und Forschungsprogramm zur langfristigen, systematischen Ökosystembeobachtung im Nationalpark Hohe Tauern Österreich), im Matschertal (Südtirol) und am Furkapass (Schweiz)

1. Brief description of the instrument

To assess potential impacts of on-going environmental change on alpine biota, a long-term ecological monitoring program was launched in the Alps. Plant, invertebrate and microbial responses will be assessed across sharp snow-melt gradients several hundred meters above tree line in five study regions. The dominant vegetation under favourable growth conditions at all these sites is a *Carex curvula* heathland (the optimum reference along the snow melt gradients), with often only a few or no flowering plant species left at the centre of such snow-beds ('pessimal' end of the gradient).

The data collected as part of this new monitoring program include (a) environmental conditions (temperature in the top soil near the meristems of all graminoids and many herb taxa), snow duration, soil physical parameters (water content – what potential responses, grain size distribution, pH and basic soil chemistry including ^{15}N signals in the soil organic fraction), (b) plant and soil animal (Oribatid mites and Collembola) species identity and abundance, (c) soil microbe spectra (molecular techniques), (d) wild animal presence (ungulates, predators; using automatic cameras).

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Nationalpark Hohe Tauern www.hohetauern.at

3. Type of instrument

- international monitoring systems

4. Status of policy instrument

- In place (since 2017)

5. Territorial coverage

- international

6. Sectoral coverage

- Sites across the Alps. Locations are ca. 150 to 450 m above the regional climatic treeline

7. Soil threats addressed by instrument

- No specific soil threats are mentioned.

8. Soil functions addressed by instrument

- hosting biodiversity pool

9. Land cover classes addressed by the instrument

- natural areas (gradients from snow-beds to *Carex curvula* heathland)

10. Monitoring sites

Monitoring sites were established in 2016 in the Hohe Tauern National Park, north and south of the main divide of the Alps, in Carinthia (Seebachtal 2300 m, Ankogel), Tyrol (Innergschlöss near Matrei, 2350 m), and Salzburg (Untersulzbachtal, 2380 m), with additional sites in northern Italy (Oberettes 2690 m, Matschertal, Ötztal-Alps) and in the Swiss central Alps (near Furka Pass 2460 m).

Source: Google Earth, from Newesely et al. 2019)

11. Parameter groups

- Site characteristics (vegetation, soil type etc.)
- Soil chemistry
  - pH-value
- Soil carbon
- Soil biodiversity
- Climate parameters
  - Soil temperature

12. Data availability

http://www.parcs.at/npht/mmd_fullentry.php?docu_id=36449

13. Monitoring mechanisms

Investigated parameters include:

- Site climate conditions, soil physics, soil chemistry, productivity
- Botanical-Vegetation Studies
- Soil mesofauna
- Culture-dependent analysis of the bacterial soil composition
- Hydrological, chemical and biological signals in micro-catchments
- Herbivores
- Cryosphere: glaciers, hydroclimate, permafrost, geomorphodynamics
- Zooplankton communities and abiotic parameters of high alpine

14. Other available information

http://parcs.at/npht/mmd_fullentry.php?docu_id=36449

Eintrag Nr. 36449 - Mehrjaehriges Monitoring- und Forschungsprogramm - Pilotprojekt

Comments by the assessor:

In Austria, the program is supported by a starting grant of the European Union and the Austrian Federal Department for Agriculture, Forestry, Environment and Water (Rural Development 2014-2020) provided through the 'Secretariat of the Hohe Tauern Nationalpark'. The Hohe Tauern Nationalpark services of Salzburg, Carinthia and Tyrol provide logistic support. The Swiss contribution is supported by the Alpine Research and Education station Furka (ALPFOR), and the Italian contribution is supported by the Autonomous Province of Bolzano/Bozen – South Tyrol. The Italian site is part of the LTSER platform Matsch|Mazia. The Swiss and Italian sites, belong to the national and international Long-Term Ecological Research Networks (LTER-Italy, LTER-Europe and ILTER).
Members of the monitoring consortium :
Christian Körner (Univ. Basel), Ulrike Tappeiner, Christian Newesely, Erwin (Universität Innsbruck), Thomas Eberl, Roland Kaiser (Fa. Ennacon KG, Salzburg), Martin Grube, Fernando Fernandez Mendoza (Universität Graz), Klaus Hackländer, Andreas Daim (Universität f. Bodenkultur Wien), Gerhard Lieb (Universität Graz) Helmut Wittmann (Haus der Natur, Salzburg)

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Questionnaire permanent monitoring sites

FR – ORCHAMP: Spatio-temporal observatory of biodiversity and ecosystem functioning of mountains' socio-ecosystems

National Name: ORCHAMP, Observatoire spatio-temporel de la biodiversité et du fonctionnement des socio-Écosystèmes de montagne

1. Brief description of the instrument

ORCHAMP is a long-term observatory of mountain ecosystems aiming to observe, understand and model biodiversity and ecosystem functioning over space and time. It relies on the active involvement of local actors, managers and researchers with the objective of a better safeguard of biodiversity's contribution to human society.

ORCHAMP is built around multiple elevational gradients (1000-1200m of elevation length) representative of the pedo-climatic space of the French Alps. Each gradient is made of 5 to 8 permanent plots distributed regularly each 200 m of altitude, from down the valley to the top. They are re-sampled on average every 5 years using a rotating sampling scheme. Measures include physical properties (soil temperature, physicochemical, and pedology), biodiversity estimates (botanical surveys, multi-trophic biodiversity using soil environmental DNA, dead wood in forests), ecosystem functions (productivity, enzymatic activities, soil organic matter) and human uses.

Data are open-access and synthetize following GEOBON recommendations on Essential Biodiversity Variables.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

ORCHAMP is a consortium gathering a large range of actors: national and regional park managers, botanical conservatory experts, natural area conservatory managers, researchers from university and research institutions. The project is led by the LECA (Laboratoire d'Écologie Alpine - https://leca.osug.fr/), located in Grenoble.

The soil protocol is implemented by the LECA for the biodiversity, ecosystem functioning and physico-chemical parts and by EDYTEM (Environnements, DYnamiques et TErritoires de la Montagne - http://edytem.univ-savoie.fr/) for the pedological part.

The forest protocols are implemented by IRSTEA (https://www.irstea.fr/en/grenoble).

Other academic institutions and all stakeholders are listed in the project website: https://orchamp.osug.fr/home

3. Type of instrument

- international monitoring systems,
- national monitoring systems,
- regional monitoring systems,

4. Status of policy instrument

- In place, since 2016

5. Territorial coverage

- regional (federal state or non-federal state),
- sub-regional.

6. Sectoral coverage

Sectors:

- agriculture,
- forestry,
- cross sectoral.

7. Soil threats addressed by instrument

- loss of soil organic matter,
- loss of soil biodiversity,

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- acting as carbon pool,
- storing geological and archeological heritage,

9. Land cover classes addressed by the instrument

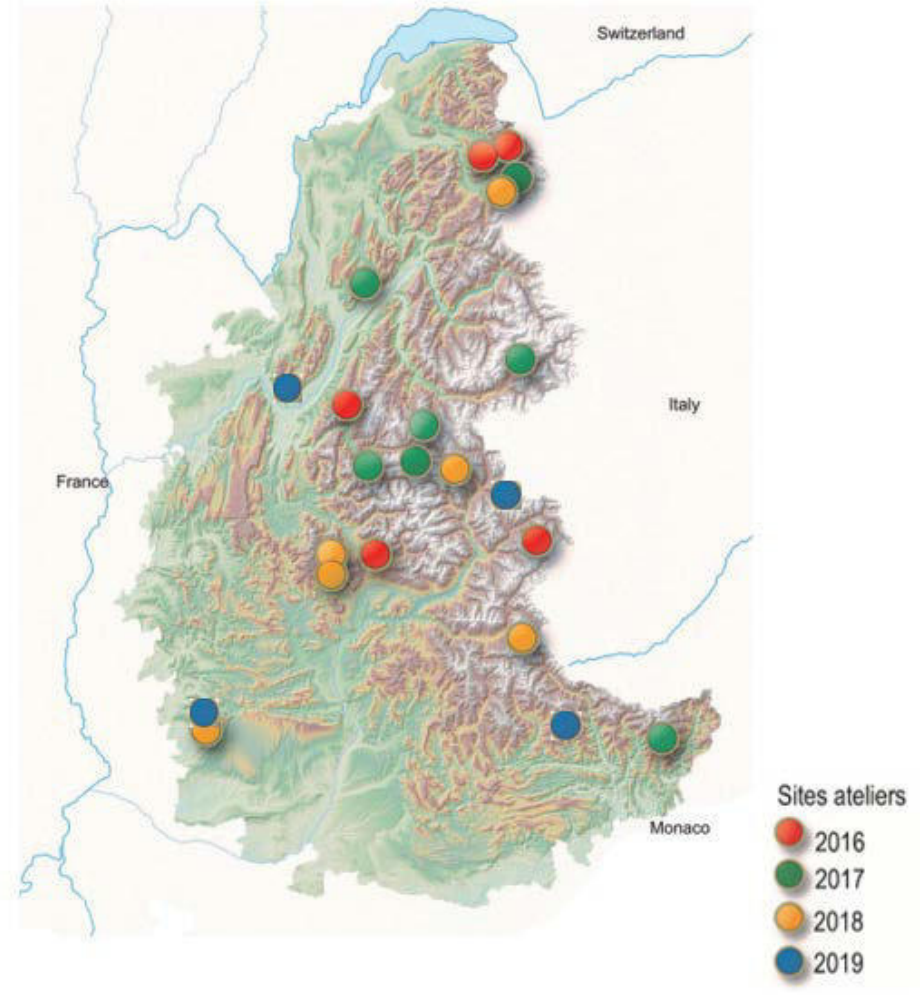
- agricultural areas,
- forests,

- semi-natural areas,
- wetlands,

10. Monitoring sites

Site Name	Number of permanents plots	Minimum altitude	Maximum altitude
Anterne	6	1400	2370
Loriaz	6	1370	2330
Chamrousse	6	1250	2180
Ristolas	6	1870	2850
Chaillol	6	2150	3160
Armenaz	4	1520	2140
Pecolz	4	962	1578
Argentière	6	1420	2400
Vanoise	8	1400	2780
Valloire	5	1860	2710
Lautaret	5	1920	2700
Lauvitel	7	1070	2150
Caramagne	6	1430	2480
Bonette	6	1900	2650
Devoluy Nord	7	1500	2670
Dévoluy Sud	7	1500	2670
Névache	5	2010	2700
Plan de l'aigille	5	1700	2450
Ventoux Sud	6	660	1645
Ventoux Nord	6	900	1660
Rachais	4	330	950
Chamechaude	5	1250	2060
Mounier	6	1810	2720
Cervières	6	1860	2310

ORCHAMP Observatory sites with their date for implementation



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Organic compounds
- Soil carbon
- Soil biodiversity
- Soil erosion
- Climate parameters
    - Soil temperature

12. Data availability

A dedicated database gathers the data from each protocol, parts of this data are downloadable on the project website: https://orchamp.osug.fr/home, the rest of the data are accessible on request.

Meta-data are available on a GeoNetwork shared by the LECA and EDYTEM: http://leca-bdgis.u-ga.fr/geonetwork/srv/fre/catalog.search#/home

13. Monitoring mechanisms

The protocols for **"superficial layer"** allow the evaluation of the soil multi-trophic biodiversity and functioning.
Sampling and analyses are performed every 5-years in average in September, at two depth 0-10cm and 10-20cm. For each sample, physicochemical parameters (pH, SOM, %C, %N) and extracellular enzymatic activities are quantified as well as total biodiversity using environmental DNA. For the latter, eight different markers are used to represent the total biodiversity of the soil. Three have been designed to amplify the three super-kingdoms of life: Eukaryota, Bacteria and Archaea. The other markers zoom into the Eukaryota diversity by targeting fungi, vascular plants, olligogeths, springtails, arthropods and insects.

The protocol for **"deep soil"** is a description of the soil profile from the surface to the bedrock, and a physicochemical analysis of the soil components to evaluate alteration/erosion.
Sampling is done once only due to a slow evolution of the soil composition in depth. The protocols are an adaptation of the French national protocol for the soil called RMQS.

This description is only concerning the mandatory protocol, few others additional parameters are measured only in some sites (litter decomposition, soil organic matter characterisation, pedoantracology …)

13. Other available information

More information are available on ORCHAMP website https://orchamp.osug.fr/home, or on request at orchamp@univ-grenoble-alpes.fr.

Comments by the assessor:

Contacts:
Project leader: Wilfried THUILLER, LECA (Wilfried.THUILLER@univ-grenoble-alpes.fr)
Project manager: Amelie SAILLARD, LECA (Amelie.SAILLARD@univ-grenoble-alpes.fr)
Soil survey leader: Jérôme Poulenard, EDYTEM (jerome.poulenard@univ-smb.fr)

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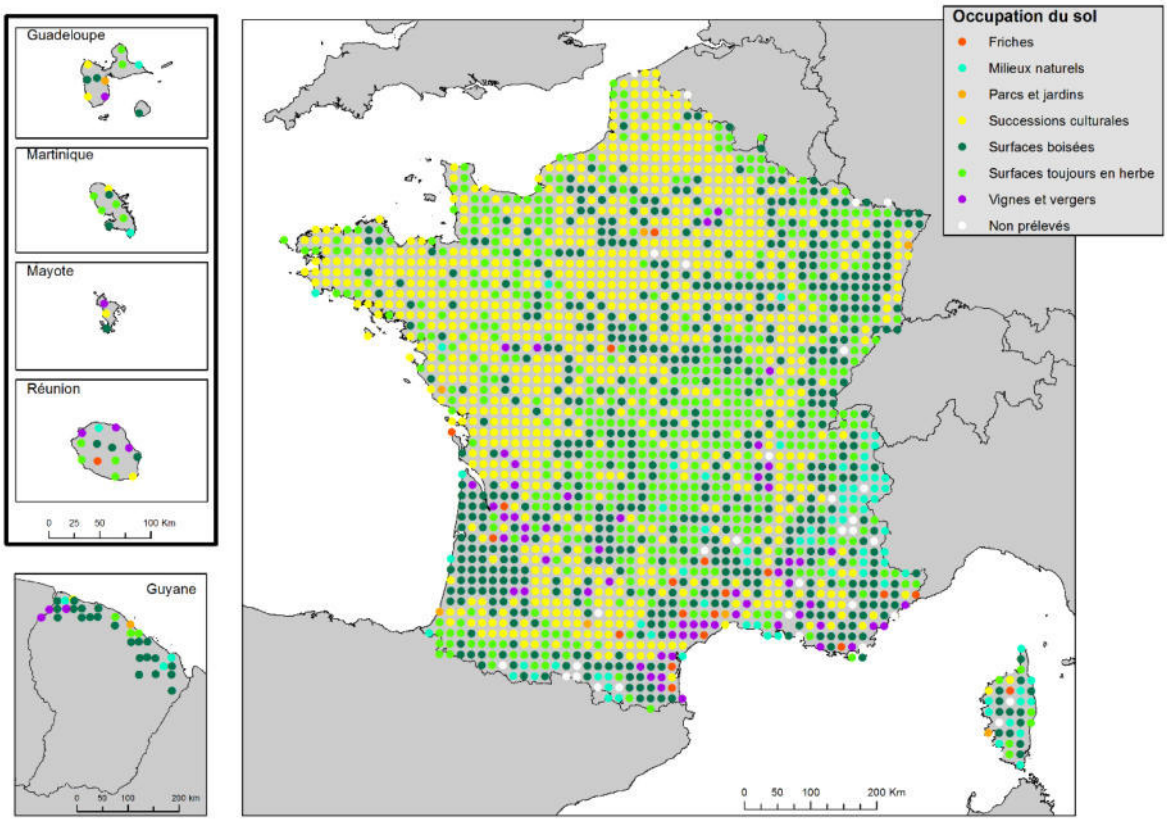
Questionnaire permanent monitoring sites

FR – RMQS

National Name: F- RMQS (Réseau de Mesures de la Qualité des Sols) - French Soil Quality Monitoring Network

1. Brief description of the instrument

RMQS is a soil monitoring network based on a 16 km regular grid across the 550,000 km2 of France. French overseas territories are also concerned. In continental France, it includes 2,173 monitoring sites, each located at the centre of a 16 x 16 km cell, for which the soil profile, site environment, climatic factors, location, vegetation and land management have been described. Composite soil samples are collected up to 1 m depth if possible. All samples are stored at INRA-Orleans in the European soil samples conservatory and data collected are available in the DONESOL database. The first campaign started in 2000 and ended in 2009 in continental France. The second campaign in ongoing.



2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Soil sampling, physico-chemical and biological analyses of RMQS are supported by a French Scientific Group of Interest on soils: the **"GIS Sol" (www.gissol.fr),** involving the French Ministry for an Ecological and Solidary Transition (MTES), the French Ministry of Agriculture and Food (MAA), the French Agency for Biodiversity (AFB), the French Institute for Forest and Geographical Information (IGN), the Environment and Energy Management Agency (ADEME), the French Institute for Research and Development (IRD) and the National Institute for Agronomic Research (INRA). INRA InfoSol in Orléans is responsible for the coordination of the overall programme.

3. Type of instrument

- National monitoring systems

4. Status of policy instrument

- In place since 2000

5. Territorial coverage

- National (MS level)

6. Sectoral coverage

Here we want to identify the sectors that the monitoring scheme covers. There may be monitoring schemes, which cover a range of sectors or are on purpose cross-sectoral. However, some may target only one or two sectors. The sectoral coverage also gives us an indication of what types of drivers behind soil degradation the instrument is likely to address. The section on territorial and sectoral coverage will also help to discern whether the spatial and sectoral coverage of the instrument is limited compared to its potential.

Sectors:

- agriculture,
- forestry,
- infrastructure,
- cross sectoral.

7. Soil threats addressed by instrument

The European Soil Thematic Strategy identifies 8 soil threats. These include: erosion, flooding and landslides, loss of soil organic matter, salinization, contamination, compaction, soil sealing and loss of soil biodiversity.

Which threats are addressed **explicitly**, i.e. the monitoring scheme explicitly aims to address the threat (this is stated in its scope, objectives, or the activities and mechanisms it includes)?

- loss of soil organic matter,
- salinization,
- contamination,
- compaction (partly, linked to changes in bulk density),
- loss of soil biodiversity (partly),

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- acting as carbon pool,

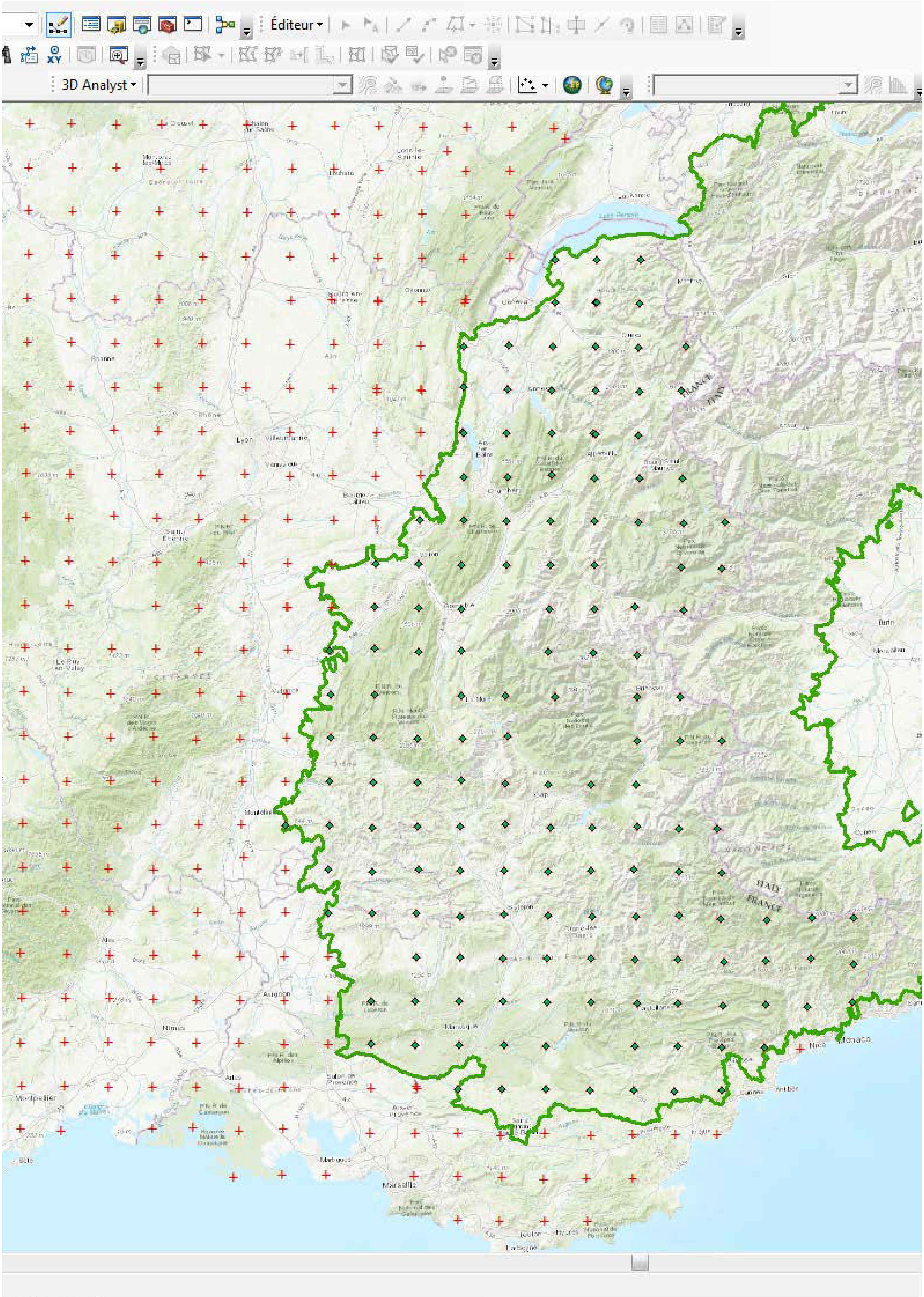
9. Land cover classes addressed by the instrument

- artificial surfaces (urban soils),
- agricultural areas,
- forests,

- semi-natural areas,
- wetlands,

10. Monitoring sites

We have 158 monitoring sites in the area (see figure below).



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3D Analyst

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Organic compounds
    - Other soil variables (nitrogen, phosphorus, particle size distribution, CEC and exchangeable cations, major elements, boron, CaCO3, etc.)
- Soil carbon
- Soil physical parameters (bulk density, soil water retention)
- Soil management and practices data
- Soil biodiversity (soil microbiology)

12. Data availability

Are data free available or restricted? Is meta-information available? Is it in line with INSPIRE?

Partly: exact coordinates of the sampling point are not available.

Data available at: https:\\data.inra.fr and https://agroenvgeo.data.inra.fr

13. Monitoring mechanisms

Since you are filling out information for monitoring schemes as such, you can provide here more detail on the monitoring scheme itself (going beyond the text that you provided above in section 1 'brief description of the instrument'). I.e.:

- What types of monitoring is included; what parameters (broad categories are sufficient) are measured and for what purpose, with what frequency?

  Soil parameters (chemical, physical and biological) are measured every 15 years for long-term monitoring soil quality.

14. Other available information

Other links to information that is relevant and useful to illustrate the monitoring scheme and its implementation. This could include, for example, guidance documents.

Web site: **https://www.gissol.fr/le-gis/programmes/rmqs-34**
Guidance document in French: **http://147.100.179.105/gissol/wp-content/uploads/2018/03/Manuel_V_Num2.pdf**

Contacts: Antonio Bispo (antonio.bispo@inra.fr) and Claudy Jolivet (claudy.jolivet@inra.fr)

Comments by the assessor:

Here you can provide any additional comments that you might have, for example:

- If you didn't think that the closed-ended questions (those with a list of answers) included the appropriate answer for the monitoring scheme in question
- If you would like to point out a specific characteristic of the instrument that is not included in the above headings.
- If you were uncertain about a particular answer, and you would like to add a comment about it
- If, for example, the instrument is very important for a particular soil threat / function even though it only deals with it implicitly, you can also comment here.
- Any other comment that you would like to make about availability of information, the nature of the instrument or anything else to communicate to the study team

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Questionnaire permanent monitoring sites

FR-RENECOFOR

National Name: RENECOFOR (REseau National de suivi à long terme des ECOsystèmes FORestiers)

1. Brief description of the instrument

RENECOFOR is the French network for the long-term intensive monitoring of forest ecosystems. It is part of the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests Level II) under the UNECE Air Convention. It comprises 102 2-ha permanent plots, covering a wide range of ecological conditions throughout France, and on which multiple parameters have been monitored with regard to the trees, to the soil, to the atmosphere, and to species diversity. It was created in response to the S1 resolution of the Ministerial Conference on the Protection of Forests in Europe (Strasbourg, 1990) and to successive EU rules for forest monitoring. Since 2018, it has contributed to the monitoring of ecosystem impacts of air pollution, as reported by France to EU "NEC" Directive n°2016/2284. RENECOFOR's repeated measurements of soil carbon stocks were also useful to the national inventory of greenhouse gas emissions under the UNFCCC and the Kyoto Protocol.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

RENECOFOR is coordinated by the French National Forest Office (ONF).

Link to RENECOFOR's webpages: http://www1.onf.fr/renecofor

3. Type of instrument

- international monitoring systems,

4. Status of policy instrument

- In place since 1992

5. Territorial coverage

- international,
- national (MS level),

6. Sectoral coverage

- forestry,

7. Soil threats addressed by instrument

- loss of soil organic matter,

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

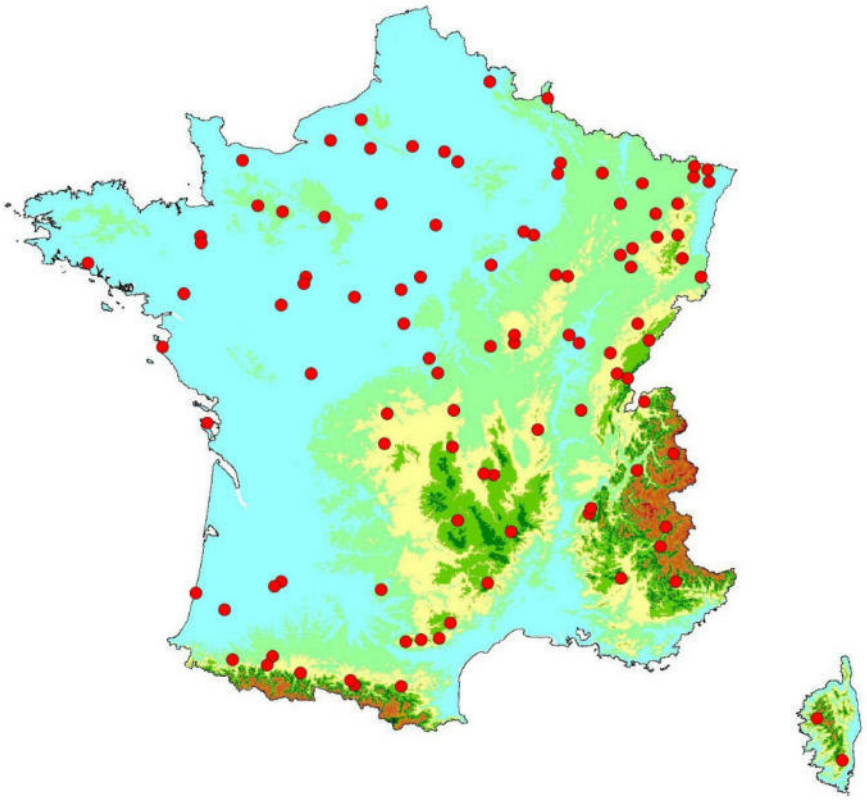
- forests,

10. Monitoring sites

List of the sites within the perimeter of the Alpine Convention:

Code	Plot level	Main tree species	Municipality	Latitude	Longitude	Altitude (m)
EPC 73	B	Picea abies	Bourg-Saint-Maurice	45°35'12'' N	6°47'23'' E	1700
EPC 74	A2	Picea abies	Saint-Cergues	46°13'42'' N	6°20'58'' E	1200
HET 04	A1	Fagus sylvatica	Noyers sur Jabron	44°07'52'' N	5°48'00'' E	1300
HET 26	A1	Fagus sylvatica	Bouvante	44°55'04'' N	5°17'46'' E	1320
MEL 05	B	Larix decidua	Champcella	44°42'18'' N	6°33'42'' E	1850
PS 04	B	Pinus sylvestris	Le Fugeret	44°01'30'' N	6°40'16'' E	1670
SP 05	A3	Abies alba	Crots	44°29'25'' N	6°27'33'' E	1360
SP 26	B	Abies alba	Bouvante	44°56'53'' N	5°19'50'' E	1150
SP 38	A3	Abies alba	La Chapelle du Bard	45°25'17'' N	6°07'53'' E	1100

Map of the whole RENECOFOR network:



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
  - Organic compounds
- Soil carbon
- Climate parameters

12. Data availability

Data are consistently stored in database and available on request, at both national and international levels.

13. Monitoring mechanisms

RENECOFOR is integrated to ICP Forests Level II so that the collected data are comparable with those from all other member states and for all surveys. The comparability of the data relies on the outstanding effort made to ensure data quality at both national and international levels: detailed and continuously updated manuals, intercalibration courses regularly organized in the field as well as control tests in labs, data stored in consistent and maintained databases.

List of surveys, depending on RENECOFOR plot level:

		Plot level			
Ecosystem component	Survey	A3 (14 sites)	A2 (13 sites)	A1 et B (75 sites)	Frequency
Trees	Stand growth survey	X	X	X	Every 5 years
Trees	Tree growth survey (with girth bands)	X	X	X	Every year
Trees	Phenology	X	X	X	Every year
Trees	Crown condition	X	X	X	Every year
Trees	Foliar nutrition	X	X	X	Every 2 years
Trees	Litterfall	X			Monthly
Diversity	Ground vegetation	X	X	X	Every 5 years
Atmosphere	Meteo station	X			Hourly
Atmosphere	Ozone concentrations and ozone-induced symptoms	X			Every year for 5 years every 10 years
Atmosphere	Bulk deposition (in open-field area)	X	X		Every 4 weeks
Atmosphere	Throughfall deposition	X			Every 4 weeks
Soil	Soil solution	X			Every 4 weeks
Soil	Solid soil analysis (C, acidity, nutrients)	X	X	X	Every 15 years

13. Other available information

Link to RENECOFOR's webpages: http://www1.onf.fr/renecofor

Link to ICP Forests' webpages: http://icp-forests.net/

Comments by the assessor:

Many forest soils and ecosystems are also under the threat of acidification and eutrophication. Even if international commitments successfully decreased the atmospheric emission of acid and N pollutants in Europe, the deposition of such compounds still exceeds the critical loads for acidification and/or eutrophication for sensitive soils and ecosystems. ICP Forests and RENECOFOR have provided useful data to evaluate the impacts of air pollution on ecosystem parameters such as soil acidity and nutrient content, tree nutrition and vitality, and ground vegetation composition.

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Soil Protection Working Group

Questionnaire permanent monitoring sites

DE – Bavarian Soil Monitoring

National Name: Bayerische Bodendauerbeobachtung

1. Brief description of the instrument

Since 1986 the soil monitoring network assesses soil characteristic values at selected dates. This allows to compare the physico-chemical state of the soil and to detect trends of soil quality over extended periods of time. The Bavarian Environment Agency (LfU) is in charge of protected areas and special sites; the agricultural areas are monitored by the Bavarian State Research Center for Agriculture (LfL) and the forest areas by the Bavarian State Institute of Forestry (LWF), respectively. Soil monitoring provides supportive data for political strategies and programs of the respective regional ministries (Bavarian State Ministry of the Environment and Consumer Protection, StMUV; Bavarian State Ministry of Nutrition, Agriculture and Forestry, StMELF).

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Bavarian Environment Agency (LfU): protected areas and special sites (https://www.lfu.bayern.de/boden/bodendauerbeobachtung/index.htm)

Bavarian State Research Center for Agriculture (LfL): agricultural areas (https://www.lfl.bayern.de/iab/boden/031470/index.php)

Bavarian State Institute of Forestry (LWF): forest areas (http://www.lwf.bayern.de/boden-klima/bodeninventur/index.php)

3. Type of instrument

- regional monitoring system

4. Status of policy instrument

- in place (since 1986)

5. Territorial coverage

- regional (federal state)

6. Sectoral coverage

- agriculture
- forestry
- cross sectoral

7. Soil threats addressed by instrument

- contamination
- loss of soil biodiversity

8. Soil functions addressed by instrument

- hosting biodiversity pool
- acting as carbon pool

9. Land cover classes addressed by the instrument

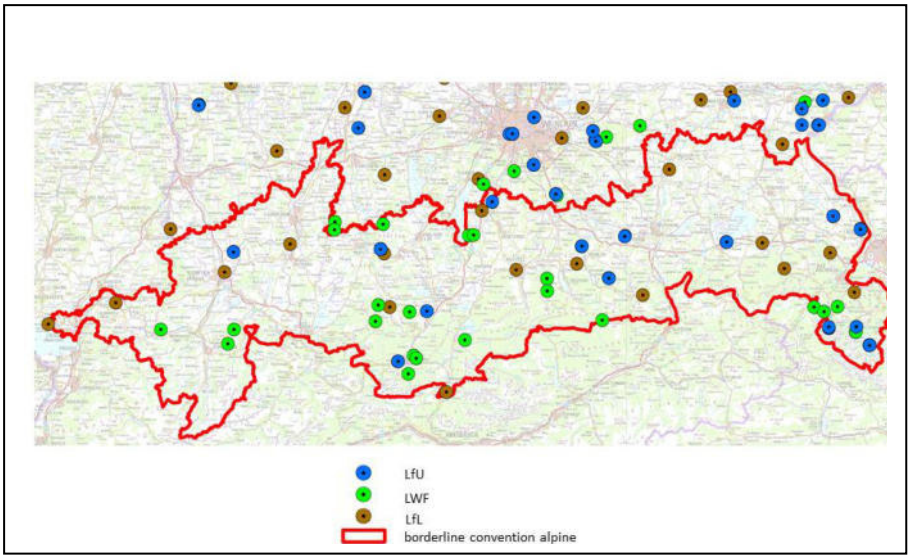
- agricultural areas
- forests
- wetlands

10. Monitoring sites of LfL, LWF and LfU

Institute	Municipality	Landuse	Years of sampling
LfU	Egling	Coniferous forest	1987
LfU	Ramsau	Pasture	1987, 2013, 2016, 2019
LfU	Freilassing	Deciduous forest	1986, 1990, 2013, 2016
LfU	Schönau	Pasture	1987, 2010, 2013, 2016, 2019
LfU	Eschenlohe	Peat bog	1987
LfU	Garmisch-Partenkirchen	Pasture	1987
LfU	Miesbach	Grassland	1987
LfU	Fischbachau	Coniferous forest	1990
LfU	Haldenwang	Coniferous forest	1987
LfU	Bad Aibling	Grassland	1987
LfU	Bernau	Peat bog	1986

LfU	Petting	Peat bog	1986, 2010
LfU	Peiting	Grassland	1987, 2010, 2013, 2016
LfL	Bayrischzell	Grassland	1986-2004
LfL	Ruhpolding	Grassland	1986-2005
LfL	Bad Reichenhall	Grassland	1986-2005
LfL	Berchtesgaden West	Grassland	1986-2004
LfL	Peiting	Grassland	1986-2004
LfL	Wangen im Allgäu Ost	Grassland	1986-2005
LfL	Tegernsee	Grassland	1985-2005
LfL	Traunstein	field	1986-2004, 2006
LfL	Mittenwald	Grassland	1986-2005
LfL	Bad Tölz	Grassland	1986-2005
LfL	Starnberg Süd	field	1986-2004, 2006
LfL	Wildpoldsried	Grassland	1986-2004
LfL	Unterammergau	Grassland	1986-2005
LfL	Wasserburg a.Inn	Grassland	1986-2004, 2006
LfL	Kressbronn am Bodensee	special use	1986-2004, 2006
LfL	Kaufbeuren	Grassland	1986-2005
LWF	Oberstaufen	forest	1988
LWF	Königssee 1	forest	1995
LWF	Tegernsee	forest	1996
LWF	Hindelang	forest	1995
LWF	Garmisch-Partenkirchen	forest	1987
LWF	Josefsthal	forest	1987
LWF	Hindelang	forest	1988
LWF	Rottach-Egern	forest	1987
LWF	Oberammergau	forest	1987
LWF	Bad Bayersoien	forest	1987
LWF	Unterammergau	forest	1986
LWF	Königssee 2	forest	1990
LWF	Bad Bayersoien	forest	1987
LWF	Schneizlreuth	forest	1988
LWF	Vorderriß	forest	1987
LWF	Berchtesgaden West	forest	1988
LWF	Königsdorf 1	forest	1986
LWF	Königsdorf 2	forest	1986
LWF	Oberammergau	forest	1987
LWF	Schongau	forest	1989
LWF	Schneizlreuth	forest	1991

Soil monitoring sites of LfL, LWF and LfU in the area of convention alpine



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
  - Organic compounds
- Soil carbon
- Soil biodiversity (earthworms)
- Climate parameters on three sites of LfU
  - Soil temperature
  - Soil moisture

12. Data availability

Data are freely available. However, they are subject to a statement of the commitment of data use and therefore have to be requested in written form.

13. Monitoring mechanisms

The Bavarian soil monitoring is associated with the Bavarian Soil Protection Law (BayBodSchG, Art. 8) and the Bavarian Soil Protection Program (Bayerisches Bodenschutzprogramm, 3.4). Further information is provided in the table above (s. point 10).

13. Other available information

https://www.lfu.bayern.de/boden/bodendauerbeobachtung/fachtagung/index.htm
https://www.lfl.bayern.de/publikationen/schriftenreihe/040862/

Comments by the assessor:

- Three LfU-sites (Gotzenalm, Wimbachgries, Hirschbichl – all in the region of the Berchtesgadener Land) of the LfU-program is equipped with soil moisture and soil temperature sensors.
- As explained in more detail on the mentioned homepages, the normal soil monitoring procedure includes destructive soil sampling. Thus, some of the soil monitoring plots will be “exhausted” after a certain amount of replicative samplings and will be abandoned.
- The LfL is observing earthworms as bionidicators on all sites, the LfU only on four sites.

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Questionnaire permanent monitoring sites

IT –Links4Soils Interreg Alpine Space Project – Outcomes for Aosta Valley – Soil mapping

National Name: Links4Soils Interreg Alpine Space Project – Produzione di cartografie del suolo della Valle d'Aosta

1. Brief description of the instrument

Links4soil Project - expected findings of Aosta Valley are:
Soil Map and a vulnerability soil erosion map,
Production of protocol of good practices to prevent soil erosion in the alpine context.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Autonomous region of Aosta Valley/Regione autonoma Valle d'Aosta – Dipartimento programmazione, risorse idriche, territorio http.//www.regione.vda.it

DISAFA – University of Torino
http://www.disafa.unito.it/do/home.pl/View?doc=offerta_formativa_DISAFA.html

https://www.alpine-space.eu/projects/links4soils/en/home

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

- in pipeline,

5. Territorial coverage

- regional (non-federal state),

6. Sectoral coverage

- agriculture,
- forestry,
- infrastructure,
- cross sectoral.

7. Soil threats addressed by instrument

- erosion,
- flooding landslides,
- loss of soil organic matter,
- compaction,
- soil sealing,
- loss of soil biodiversity,

8. Soil functions addressed by instrument

- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- artificial surfaces,
- agricultural areas,
- forests,
- semi-natural areas,
- wetlands,
- water bodies,

10. Monitoring sites

The whole regional territory is concerned

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Organic compounds
- Soil carbon
- Soil biodiversity
- Soil erosion
- Climate parameters
    - Soil temperature

12. Data availability

Data available

Meta-information available

13. Monitoring mechanisms

Under definition

13. Other available information

https://www.alpine-space.eu/projects/links4soils/en/home
https://alpinesoils.eu/
https://it.alpinesoils.eu/

Comments by the assessor:

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Questionnaire permanent monitoring sites

Country Prefix – Name of the monitoring scheme

National Name:

1. Brief description of the instrument

The monitoring approach is based on carbon fluxes observational sites. The main scope of the observational sites is the measure of CO2 and water fluxes between the vegetation and the atmosphere, but monitoring activities are highly intertwined with soil processes and evolution.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Environmental Protection Agency of Aosta Valley (www.arpa.vda.it/climatechange)

3. Type of instrument

international monitoring systems,

4. Status of policy instrument

- In place (2008-on going)

5. Territorial coverage

- sub-regional.

6. Sectoral coverage

- agriculture,
- forestry,
- cross sectoral.

7. Soil threats addressed by instrument

- loss of soil organic matter,

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,
- semi-natural areas,

10. Monitoring sites

IT-Tor

The site is located in the northwestern Italian Alps (Aosta Valley, IT) at an altitude of 2160 m a.s.l. (45°50'40''N, 7°34'41''E). The area is a subalpine unmanaged grassland. Dominant vegetation consists of Nardus stricta L., Festuca nigrescens All., Arnica montana L., Carex semper- virens Vill., Geum montanum L., Anthoxanthum alpinum L., Potentilla aurea L., Trifolium alpinum L.. The terrain slopes gently and the soil is classified as Cambisol (FAO/ISRIC/ISS). The site is characterized by an intra-alpine semi-continental climate, with mean annual temperature of 3.1°C and mean annual precipitation of about 880 mm. On average, from the end of October to late May, the site is covered by a thick snow cover (90–120 cm) which limits the growing period to an average of five months. Further information regarding the site can be found in . Continuous CO2 and water fluxes measures (eddy covariance method), meteorological, phenological and proximal sensing observations are carried out since 2008. Beside LTER network, the experimental site belongs also to the to the ICOS (IT-Tor **https://www.icos-ri.eu/**) and Phenocam (Torgnon-nd, https://phenocam.sr.unh.edu/webcam/) networks.

IT-Trf

The European larch forest is located at 2100 m asl (45.82387N, 7.55459E), close to the village of Torgnon (AO). The site is one of the most widely distributed ecosystems in the Aosta Valley and the Alps. The stand is composed by European larch (Larix decidua Mill.) as the dominant species and by sporadic spruce (Picea abies) individuals. The forest is quite open, allowing the growth of vigorous understory vegetation, composed mainly by shrubs, such as Rhododendron Ferrugineum, Juniperus communis, and Vaccinium spp. and grasses such as Arnica montana and Poa alpina. Mean tree height is 10 m and mean tree age is 120 years. The climate is characterised by a mean annual temperature of +2.31°C and a mean

annual precipitation of 880 mm. On average from November to late May the ground is covered by snow with an average of 0.70 m and a maximum of 1.95 reached in winter 2018. At the site, different observations are carried on in order to evaluate the climate change impacts on the structure and function of the ecosystem. In 2005 direct observations of the main phenological events have been started at the site, while since 2010 eddy covariance measurements of CO2 fluxes are carried on. Monitoring of phenology is also carried on by means of digital cameras installed on the top of the eddy covariance tower and since 2015 measurements of the sap flow in trunks are available. Beside LTER network, the site belongs also to the to the Fluxnet and Phenocam networks

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Organic compounds
- Soil carbon
- Climate parameters
    - Soil temperature

12. Data availability

Are data free available or restricted: FREE

Is meta-information available? YES

Is it in line with INSPIRE? NO

13. Monitoring mechanisms

13. Other available information

http://www.arpa.vda.it/it/effetti-sul-territorio-dei-cambiamenti-climatici/pubblicazioni/articoli

Comments by the assessor:

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Questionnaire permanent monitoring sites

IT – GLACIER-RELATED RISK MONITORING PLAN

National Name: Monitoraggio rischi glaciali e periglaciali

1. Brief description of the instrument

Because many different potentially hazardous glaciers are located in the surroundings of populated areas or near major infrastructure, the Autonomous Region of Aosta Valley has devised a regional glacial risk monitoring plan together with the Fondazione Montagna Sicura.
This gives them an overview of the regional risk situation. Every potentially hazardous glacier has a detailed folder linked to the GIS database containing historical material, updated photographs etc. Whenever any of the existing or new potential risk situations seem to require further investigation, field surveys take place and the respective phenomena can start to be monitored in precise spots.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Fondazione Montagna Sicura (http://www.fondazionemontagnasicura.org)

Snow & Avalanches Regional Bureau Management_ Autonomous region of Aosta Valley/Regione autonoma Valle d'Aosta (Ufficio Valanghe – http://ww.regione.vda.it)

3. Type of instrument

- international monitoring systems
- regional monitoring systems

4. Status of policy instrument

- In place (from 2012 to today),

5. Territorial coverage

- regional (non-federal state),

6. Sectoral coverage

- cross sectoral.

7. Soil threats addressed by instrument

- No specific soil threats are mentioned.

8. Soil functions addressed by instrument

- storing, filtering, transforming nutrients or water,
- providing raw materials,
- storing geological and archeological heritage.

9. Land cover classes addressed by the instrument

- water bodies,

10. Monitoring sites

The monitoring plan is primarily based on the 184 glaciers of Aosta Valley.

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil erosion

12. Data availability

The gathered data are restricted and available only for the Aosta Valley Autonomous Region.

13. Monitoring mechanisms

The monitoring plan is primarily based on the GIS database of the glaciers of Aosta Valley. A series of potentially hazardous glaciers has been identified in a study of historical glacial hazardous events. Part of this study was carried out on the entire Alpine territory, thanks to the Glaciorisk project. The database has been completed with additional local research and is updated annually. Every year, local stakeholders such as Alpine guides and refuge owners report new glacial lakes, serac falls and other hazardous events. FMS then has the responsibility to verify the risk level of these events. At the end of every summer, technicians from the FMS glacier office perform a helicopter flight with a precise flight plan covering all of the 184 glaciers of the region. During the flight, photographs of all Aosta Valley glaciers are taken. This gives them an overview of the regional risk situation.

13. Other available information

http://app.fondazionemontagnasicura.org/multimedia/crgv/

Comments by the assessor:

The population is encouraged to report any relevant observations. As of now, the GIS database contains 26 potentially hazardous glaciers. On three of them, special monitoring actions have been activated (Whymper Serac/Grandes Jorasses, Planpincieux Glacier tongue, and the Brenva glacier and rock face).

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Questionnaire permanent monitoring sites

IT – Regulation (EC) No 1221/2009 – EMAS III, Environmental Management System (EMS) – Parco Naturale Mont Avic, Valle d'Aosta

National name: Regolamento CE 1221/2009 – EMAS III. Sistema di Gestione Ambientale – Parco Naturale Mont Avic, Valle d'Aosta

1. Brief description of the instrument

EMS - Procedure 446-02 - Alpine pastures and pastures. Monitoring of the transhumance of the cattle in the mountain pastures through field surveys carried out by the Park staff.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Implementation: Parco Naturale Mont Avic (https://www.montavic.it/)

Evaluation: accredited certification body (it changes over time, currently RINA spa - https://www.rina.org) [ISPRA validate only the Environmental Statements and not the single procedures]

3. Type of instrument

- international monitoring system

4. Status of policy instrument

- In place (from 2003-today)

5. Territorial coverage

- sub-regional.

6. Sectoral coverage

- agriculture,

7. Soil threats addressed by instrument

- No specific soil threats are mentioned.

8. Soil functions addressed by instrument

- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,
- semi-natural areas,

10. Monitoring sites

Parco Naturale Mont Avic (see www.montavic.it)

11. Parameter groups

12. Data availability

Meta-information available (Environmental Statements, subsequent editions from 2003 to the present)

(The detailed data must be treated with reference to the privacy regulation)

13. Monitoring mechanisms

Grazing activity (number of animals for each category of the cattle transhumance on each pasture sector, indicating the period of pasture)

13. Other available information

Comments by the assessor:

About question 2: The procedure is managed under an EMS in accordance to the EMAS regulation; the methodology is chosen independently by the organization and therefore it is not intended as an internationally shared protocol.

About question 7: Implicitly, the monitoring system could be used to assess the following threats:

- erosion,
- compaction,
- loss of soil biodiversity.

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Questionnaire permanent monitoring sites

Please send your feedback ***by FR, 13.09.2019*** *to vera.bornemann@alpconv.org to allow us to prepare an overview of the results for the 2nd meeting of the working group.*
When filling out this document, please do not use footnotes. If you would like to make comments, use the Comments section at the end. Please delete this instruction text and the other instructions in the document. Just keep the answers. Please copy the questionnaire as many times as needed starting with a new page for every monitoring scheme, or use separate document for every monitoring scheme you will send in.

IT – Soil erosion in sloping vineyards

National Name: Erosione del suolo su vigneti in forte pendenza

1. Brief description of the instrument

The University of Torino, DISAFA (Department of Agricultural, orest and Food Sciences) is carrying on an experiment on soil erosion in a vineyard managed by Institut Agricole Régional in Aosta (IT). The experiment, currently part of the Links4Soil Interreg Project (https://www.alpine-space.eu/projects/links4soils/en/home), aims at defining best practices for different land use and management types. The effects of weed killing vs permanent grassing on soil erosion are being studied in a sloping mountain vineyard (40% slope) located in Aosta (N-W Italy). Eighteen tanks for the collection of sediments and runoff were set at the end of the rows. The amount of runoff, the erosion rate and the properties of eroded soil (nutrients, texture) are recorded after each rainfall event occurring from April to November. The expected outcomes are: 1) better understanding the effect of different management types on soil erosion; 2) assessing the effects of soil management on the ecosystem services provided; 3) recommending best practices in order to mitigate soil degradation. In addition, the experiment will help assessing threshold for erosive rainfall events in the study area.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

IAR – Institut Agricole Régional http://www.iaraosta.isiportal.com/

DISAFA – University of Torino
http://www.disafa.unito.it/do/home.pl/View?doc=offerta_formativa_DISAFA.html

https://www.alpine-space.eu/projects/links4soils/en/home

3. Type of instrument

- international monitoring systems;
- regional monitoring systems.

4. Status of policy instrument

- In place since 2014

5. Territorial coverage

- sub-regional.

6. Sectoral coverage

Sectors:

- agriculture.

7. Soil threats addressed by instrument

- erosion,
- loss of soil organic matter.

8. Soil functions addressed by instrument

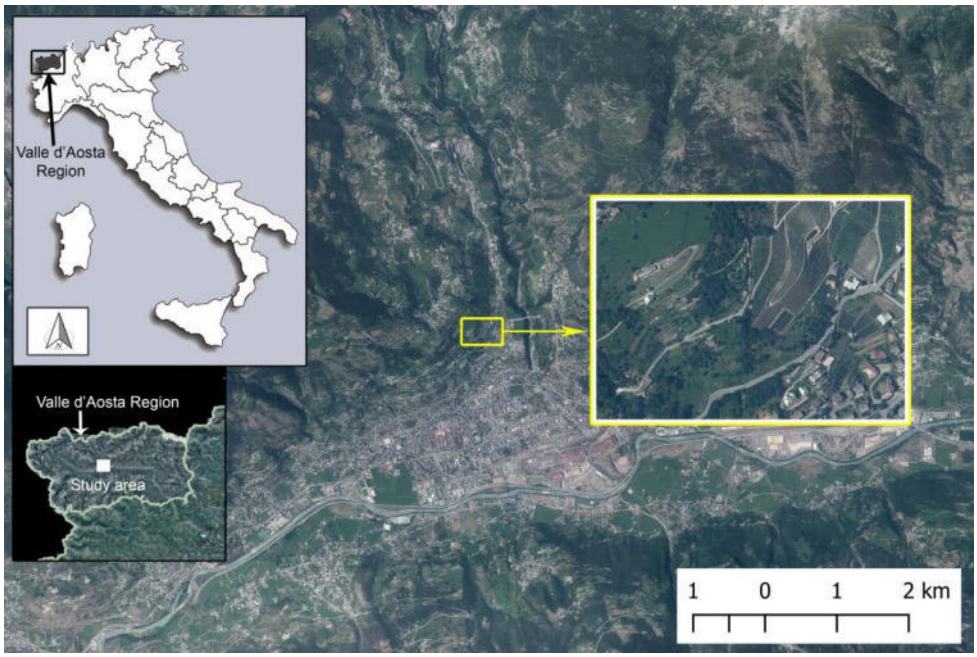
- biomass production,
- storing, filtering, transforming nutrients or water.
- hosting biodiversity pool,
- platform for human activity.

9. Land cover classes addressed by the instrument

- agricultural areas

10. Monitoring sites

Moncenis, in the municipality of Aosta, Valle d'Aosta region, North-West Italy.
Latitude, Longitude: 45.7491, 7.3143.



11. Parameter groups

- Site characteristics (soil type etc.) : soil type, slope%, Soil chemistry and physics
    - pH
    - C and N contents Wet aggregate stability (topsoil)
    - Liquid and plastic limit (topsoil)
- Soil erosion (run-off, sediment release, erosion rate)
- Air temperature, RH, Wind speed and direction, rainfall and rain rate

12. Data availability

The results will be available on a report on the project website,

13. Monitoring mechanisms

- Soil erosion is affecting large areas worldwide, especially on steep slopes where soil development is limited and the soil formation rate is particularly low. In Aosta Valley, according to CERVIM (2016), vineyards cover 522 Ha. Around 60% of this surface lays on difficult terrains for different reasons, such as relatively high altitude (>500 m asl), slope exceeding 30%, and presence of man-made terraces that can help reducing erosion but also limit access and mechanization. Row orientation (up and down or orthogonal to the slope by earth embankments) and soil management (grass cover or bare soil), as well as tractor passages can greatly influence soil erosion and runoff. Runoff and soil sediments are collected at the end of the inter-rows. Runoff volumes are measured after every important precipitation event (from April 1st to October 30th). Soil erosion is estimated and soil sediments are sampled and analysed after every relevant erosion event and/or at the end of the season. The experimental design is a RCBD with 3 replicates and 3 treatments (complete grass cover, bare soil, grass buffer strip). Each experimental plot is made of

two subplots (two adjacent inter-rows), one being subject to tractor passage several times per season, the other undisturbed.

13. Other available information

A video on the experimental site management will be available soon on the Links4Soil website (https://www.alpine-space.eu/projects/links4soils/en/home)

http://www.cervim.org/v.aspx
Two abstracts presented at the CERVIM 2017 Congress (pages 175-176 and 178)

Comments by the assessor:

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Questionnaire permanent monitoring sites

IT – Italian Land Use Inventory

Inventario dell'Uso delle Terre d'Italia- IUTI

1. Brief description of the instrument

The Italian Land Use Inventory (IUTI) is a point sampling based inventory. It was originally conceived as a key instrument of the National Registry for forest carbon sinks by the Italian Ministry of Environment and then updated by University of Molise and ISPRA. IUTI has monitored the land use and land use changes in the last three decades over the country at the years 1990, 2000, 2008, 2013, 2017, adopting a tessellated stratified sampling scheme with about 1.206.000 million sample points on aerial orthophotos using six GPG-LULUCF categories of the IPCC, divided into 15 subclasses. These sample points show the heavy changes affecting surface and distribution of the various land use classes over time. Many implementation and cross analysis have been carried out using IUTI to extend land use monitoring to specific landscape features (e.g., trees outside forests, clearings, urban greenspaces) and to assess land use change impacts on ecosystems.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Ministry of the Environment, Land and Sea, University of Molise and ISPRA

3. Type of instrument

- national monitoring systems

4. Status of policy instrument

- In place (since 1990),

5. Territorial coverage

- national (MS level),

6. Sectoral coverage

- cross sectoral.

7. Soil threats addressed by instrument

- soil sealing

8. Soil functions addressed by instrument

- acting as carbon pool

9. Land cover classes addressed by the instrument

- artificial surfaces,
- agricultural areas,
- forests,
- semi-natural areas,
- wetlands,
- water bodies,

10. Monitoring sites

IUTI is composed by 1.206.000 random sampling points covering the whole national territory. Land use classes was assigned through visual photointerpretation of a time-series of digital aerial orthophotosbased on the dominant land use in a 0.5 ha range around the sampling points. The whole set of sampling points can be modified according to specific territorial analysis (i.e., subsampling schemes for the Alpine Convention territory)

11. Parameter groups

- Land use

12. Data availability

To be verified

13. Monitoring mechanisms

IUTI was originally conceived and implemented as a key instrument of the National Registry for forest carbon sinks, through the analysis of land use and land cover changes and their impacts on carbon storage. However, its sampling scheme combined with the possibility to be integrated with other cartographic and inventory information allowed to further extend its range of implementation to specific issues as already done by LUCAS at EU scale.

The possibility to integrate cartographic and inventory approaches, allowed to extend its range of activities beyond the land use and land cover changes monitoring. It is indeed now possible to use IUTI as a base for environmental impact assessment analysis related to such landscape changes (e.g., impacts on carbon storage and sequestration, crop production, timber production, land capability etc.). All the implementation can both cover the whole national territory as well as its smaller portions (e.g., province, region).

13. Other available information

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Caddeo A., Marras S., Sallustio L., Spano D., Sirca C. (2019). Soil organic carbon in Italian forests and agroecosystems: Estimating current stock and future changes with a spatial modelling approach. Agricultural and Forest Meteorology Volume 278. https://doi.org/10.1016/j.agrformet.2019.107654

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Pagliarella M.C., Sallustio L.,Capobianco G., Conte E., Corona P., Fattorini L., Marchetti M. (2016). From one- to two-phase sampling to reduce costs of remote

sensing-based land cover inventories. Remote Sensing of Environment, 184, 410–417. doi:10.1016/j.rse.2016.07.027

Sallustio L.,Munafò M., Riitano N., Lasserre B., Fattorini L., Marchetti M. (2016). Integration of land use and land cover inventories for landscape management and planning in Italy. Environmental Monitoring and Assessment, 188(1): 1-20. doi: 10.1007/s10661-015-5056-7

Sallustio L.,Simpatico A., Munafò M., Giancola C., Tognetti R., Vizzarri M., Marchetti M. (2015). Recent trends in forest cover changes: only positive implications? L'Italia Forestale e Montana, 70 (4): 273-294. doi: http://dx.doi.org/10.4129/ifm.2015.40.03

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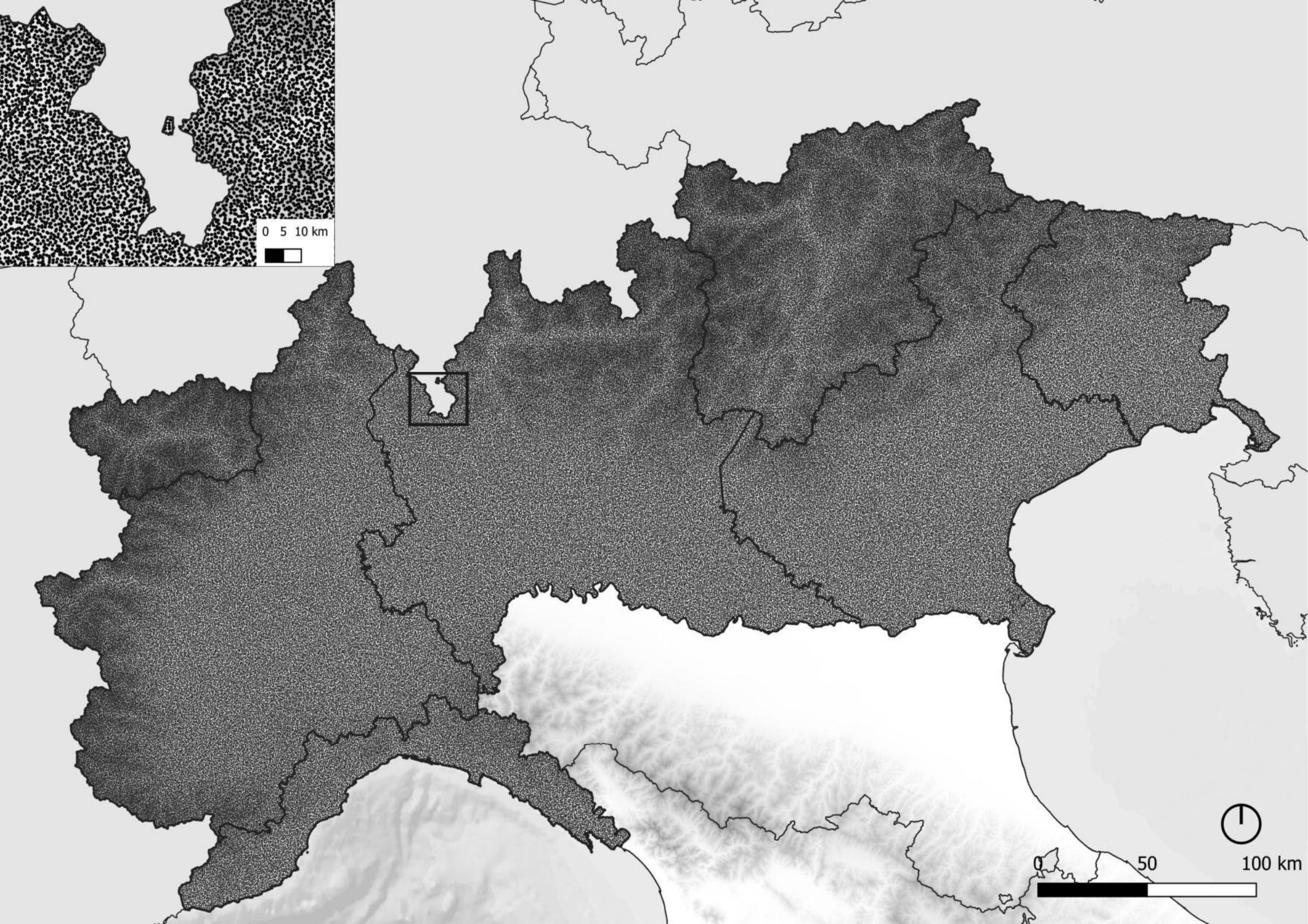
Marchetti M., Ottaviano M., Pazzagli R., Sallustio L., (2013). Consumo di suolo e analisi dei cambiamenti del paesaggio nei Parchi Nazionali d'Italia. Territorio, 66: 121-131. DOI: 10.3280/TR2013-066021

Comments by the assessor:


0 5 10 km
0 50 100 km

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT - ARPA CMG - Lombardy Environmental Protection Agency - Geological Monitoring Center

CMG – Centro Monitoraggio Geologico della Lombardia

1. Brief description of the instrument

Arpa Lombardia manages the Geological Monitoring Center of Lombardy, where a systematic geological monitoring activity began following the flood of Valtellina (July 1987) with the construction and activation of the first control networks on the landslides of Val Pola (1987), Val Torreggio (1988) and in the Campo Franscia area (1988). Since then, the Geological Monitoring Center (CMG) established by the Lombardy Region has been active and subsequently transferred to ARPA Lombardia (April 2003). The Lombard warning system for large landslides is focused on CMG.

The network is equipped with surface type measuring points (strain gauges, crack meters, distometers, wall inclinometers), in the hole (inclinometer tubes / probes, multibase extensometers, piezometric tubes / probes, inclinometer chain, multi-parameter DMS, "TDR" cables) , Interferometry radar (ground and satellite), Topographic (Total station, GPS antennas) and Pluvio-Meteorological (Rain gauge, Snow meter, Thermometer, Barometer, Anemometer, Hydrometer, Hygrometer, Albedometer).

Landslides monitored: 44

Landslides with real-time data transmission: 33

Landslides for alert purposes: 28

Inclinometric measurements: about 15.000 meters per year

Dystometric measurements: over 2.000 readings per year

Piezometric measurements: over 160 measurements per year

Topographic and GPS campaigns: 48 + 41 campaigns per year

automatic acquisition sensors: 1088

Data acquisition and transmission stations: 137

Geotechnical data: approximately 12.006.038 data / year

Hydrometeorological data: approximately 8.462.160 data / year

Total data acquired every year in automatic mode: about 20.468.198

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

ARPA Lombardia – Agenzia Regionale per la Protezione ambientale della Regione Lombardia (www.arpalombardia.it) - [The Environmental Protection Agency of the Lombardy Region]

Regione Lombardia (www.regione.lombardia.it) [Lombardy Region]

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

- In place (since 1987)

5. Territorial coverage

- regional (non-federal state),

6. Sectoral coverage

- cross sectoral

7. Soil threats addressed by instrument

- landslides, flooding

8. Soil functions addressed by instrument

- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- artificial surfaces,
- agricultural areas,
- forests,
- semi-natural areas,

10. Monitoring sites

https://www.arpalombardia.it/Pages/Monitoraggio-Geologico/Le-aree-monitorate.aspx

11. Parameter groups

- other

12. Data availability

The locations and characteristics of the instruments are available on the website. The data deriving from the instrumental monitoring are available on request or on the site with restricted access.

13. Monitoring mechanisms

The network is extensive and includes depth and surface control tools such as inclinometer tubes / probes, multi-base strain gauges, piezometric tubes / probes, inclinometer chain, DMS multiparameter, "TDR" cables, ground and satellite radar interferometry, total station, GPS antennas, Rain gauge, Snow meter, Thermometer, Barometer, Anemometer, Hydrometer, Hygrometer, Albedometer which allow to know the evolution of landslide movements over time.
The number of sites to be monitored varies according to the indications of the Lombardy Region, while the number of tools to be installed derives from the analyzes and studies on the phenomena observed, which are translated by the Geological Technicians of the Center into specific projects, where the methods are also indicated. (automatic or manual) and the timing of acquisition of sensor data.

14. Other available information

The website https://www.arpalombardia.it/Pages/Monitoraggio-Geologico/Le-aree-monitorate.aspx presents for each failure at least the following information:
name and description of the failure, municipality in which it exists, year from which it is monitored, method of data acquisition, number and type of data transmission systems, list of instruments installed with automatic detection and manual detection, number and type of campaigns measurement expected in the year, number of data acquired in a year, image with location of sensors, CTRL map of classification, some images of failure and sensors.

Comments by the assessor:

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – Soil Quality Monitoring in Lombardy (North Italy)

National Name: Monitoraggio delle qualità dei suoli agricoli della Lombardia.

1. Brief description of the instrument

Monitoring is based on the detection of a large set of environmental and agronomic indicators related to soil qualities/properties and soil management practices. Data are gathered from sites representative of the pedoclimatic conditions and cropping systems that characterize the Lombardy Po plain. Monitoring activity is carried out in the framework of projects financed under successive projects financed by both EU programs (e.g. LIFE) and Regional decisions. Results are expected to contribute to the application of climatic and agro-environmental policies at regional level, with respect in particular to the Rural Development Plans and the mitigation/adaptation to climate change strategies (ref.: Agenda 2030 goals; Paris Commitment). To this purpose, the monitoring is mainly focused on SOC (Soil Organic Carbon), diversification of cropping systems, edaphic biodiversity, water, energy and fossil fuel consumption. More information available on www.lifehelpsoil.eu

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

ERSAF – Ente Regionale per I Servizi all'Agricoltura e alle Foreste

Via Pola 12, 20124 Milano (Italy) – www.ersaf.lombardia.it

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

- In place (since 2010, under successive projects),

5. Territorial coverage

- regional (federal state or non-federal state),

6. Sectoral coverage

Sectors:

- agriculture,

7. Soil threats addressed by instrument

- loss of soil organic matter,
- compaction,
- loss of soil biodiversity,

8. Soil functions addressed by instrument

- biomass production,
- hosting biodiversity pool,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

- agricultural areas,

10. Monitoring sites

Monitoring sites are located on the Lombardy plain, within normal farms. Main soil types are Cambisols, Luvisols and Vertisols. Cropping systems mainly include the cultivation of cereals, maize, soybean, forage crops and rice.

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
- Soil carbon
- Soil biodiversity

12. Data availability

Data are available and published within the final report of the projects that included the monitoring activity mentioned. Also meta-information is provided there. It is in line with INSPIRE (as I know).

13. Monitoring mechanisms

Monitoring is addressed in particular to assess the SOC stock occurring in the agricultural soils and its variation over the time, under different tillage management practices (conventional/ploughed, minimum tillage, no tillage) and crop rotations (including and not including cover crops). Data collected are integrated with a modelling approach to simulate the SOC increasing/decreasing rate. Monitoring of edaphic biodiversity is based on the QBS-ar index and the detection of earthworms occurrence in the topsoil. According to local conditions and environmental problems occurring in specific areas also the soil content of heavy metals, nutrients and soluble salts as well of soil structure stability are detected. In any case scientific methods are applied for both soil sampling, field measurements and laboratory analysis.

13. Other available information

www.lifehelpsoil.eu
www.ersaf.lombardia.it
"AgroEnvironmental aspects of conservation agriculture compared to conventional systems: a 3-years experience on 20 farms in the Po Valley (Northern Italy)", in Agricultural Systems n. 168 (2019), 73-87, Elsevier The Netherlands;
"Soil carbon sequestration and biological activity in Conservation Agriculture systems in North Italy", in Atti (MTA CAES Geoghraphical Institute Budapest, 2016: ISBN 978-963-9545-50-2) "International Conference on Conservation Agriculture and Sustainable Land Use", Budapest (Ungheria), 31 maggio – 2 giugno 2016;
"Il ruolo dell'agricoltura conservativa nel bilancio del carbonio – AgriCO_2ltura", Quaderni della Ricerca n. 153, 137 pp. Regione Lombardia, giugno 2013 – coordinamento di progetto e autore capitoli 2.1 e 3.1;
"Soilqualimon – Sistema di monitoraggio della qualità dei suoli di Lombardia", Quaderni della Ricerca n.110 su CD Rom, Regione Lombardia, maggio 2010;

Comments by the assessor:

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – ARMOSA – Soil and cropping system monitoring established in Lombardy to implement the Nitrates Directive

National Name: ARMOSA – rete di monitoraggio dei suoli e dei sistemi agricoli nell'ambito dell'applicazione della Direttiva Nitrati in Lombardia

1. Brief description of the instrument

Monitoring is based on 6-8 permanent sites representative of pedoclimatic conditions and fertilization practices normally adopted by farms, both zootechnic and cereal farms, in Lombardy. Monitoring activity concerns the content and dynamic of nutrients – nitrogen/nitrates and phosphorous – through the soil, from the surface down to 90 cm. Soil sampling and analysis are carried out every 15-30 days in each site according to the crop growing season; soil water content is detected in continuum by soil probes connected to a data-logger. The ARMOSA monitoring system has been identified by Lombardy Region in order to comply with the requirements laid down by the EU Nitrates Directive (91/676/CEE) and regulation taken at national and regional level.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

ERSAF – Ente Regionale per I Servizi all'Agricoltura e alle Foreste

Via Pola 12, 20124 Milano (Italy) – www.ersaf.lombardia.it

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

- In place (since 2005)

5. Territorial coverage

- regional (federal state or non-federal state),

6. Sectoral coverage

Sectors:

- agriculture,

7. Soil threats addressed by instrument

- contamination,

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,

9. Land cover classes addressed by the instrument

- agricultural areas,

10. Monitoring sites

Monitoring sites are located on the Lombardy plain, within normal farms. Main soil types are Cambisols, Luvisols and Vertisols. Cropping systems mainly include the cultivation of cereals, maize, soybean, forage crops and rice. Fertilisation practices monitored include the distribution of livestock manure, digestate and mineral fertilizers.

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - Nutrient content (nitrates and phosphates)
    - Heavy metal concentrations
- Soil carbon
- Climate parameters
    - Soil water content

12. Data availability

Data are processed yearly and published on the website of ERSAF and Lombardy Region (Agriculture). Moreover, data are delivered to the national authorities (Minister of Environment) for reporting aims of Nitrates Directive implementation to the European Commission.

13. Monitoring mechanisms

The ARMOSA monitoring system is complementary to that is provided by the Regional Environmental Agency (ARPA) with respect to the quality of surface and groundwater. At the beginning ARMOSA was a project aimed at collecting measured data to develop and validate a deterministic model – also called ARMOSA – addressed to simulate the environmental fate of nitrogen compounds in the soil-plant-atmosphere system (e.g.: nitrates leaching, ammonia and N_20 volatilization). The model has been used, and is still used, to assess the impact of current and improved fertilization practices on the environment (water and air quality). To this purpose, the monitoring activity also includes data recording of nitrogen supplied to crops with manure and fertilizers, nitrogen uptake by plants and crops yields and management practices adopted by farmers.
From 2011 ARMOSA sites have taken officially on the role of soil and cropping system monitoring in the frame of the Nitrates Directive implementation in Lombardy. Nowadays it is under consideration the revision of the monitoring network, in order to set out a more targeted approach able to reduce costs, limiting the number of indicators/parameters monitored, and increase the number of monitoring sites.

13. Other available information

www.ersaf.lombardia.it

www.regione.lombardia.it (Agricoltura)

"The ARMOSA simulation crop model: overall features, calibration and validation results", in Italian Journal of Agrometeorology n. 3/2013, pp 23-38;

"Crop rotation, fertilizer types and application timing affecting nitrose leaching in nitrate vulnerable zones in Po Valley", in Italian Journal of Agrometeorology n. 2/2013, pp 39-50;

"Nitrate leaching under maize cropping systems in Po Valley (Italy)", in Agriculture, Ecosystems and Environment 147(2012) pp. 57-65, online dal 6 luglio 2011;

Comments by the assessor:

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – Environmental Monitoring Project throughout the Lombardy Region (Soil Project): fact-finding survey of the quality and state of health of Lombardy soils

Progetto di Monitoraggio Ambientale su tutto il Territorio della Regione Lombardia (Progetto Soil): Indagine conoscitiva della qualità e dello stato di salute dei suoli lombardi

1. Brief description of the instrument

The Lombardy Region funded the ISPRA JRC for the "Environmental Monitoring Project for the whole territory of the Lombardy Region (Soil Project): a survey on the quality and state of health of Lombardy soils", the report of which was published in 2015 on the website of the EU Commission:

https://ec.europa.eu/jrc/en/publication/progetto-di-monitoraggio-ambientale-su-tutto-il-territorio-della-regione-lombardia-progetto-soil

In this project, a monitoring network was defined on the entire regional territory, referring to the Lucas network.

The aim of the project was to carry out a screening of the health and quality of the agricultural soils of the Lombardy Region, through a multidisciplinary chemical, physical and biological approach, through which to obtain the so-called "zero point".

The project was divided into two phases: the first general screening in which 156 soil samples were collected and analyzed, taking mainly into consideration the soil used for agricultural activity; the second phase took into consideration seven areas where there is a known or at least suspect critical situation.

However, no replicas of the project are foreseen (to date an update of the work is not expected).

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Lombardy Region and ISPRA

3. Type of instrument

- regional monitoring systems

4. Status of policy instrument

- In place (2015),

5. Territorial coverage

- regional,

6. Sectoral coverage

- agriculture.

7. Soil threats addressed by instrument

- no specific soil threats are mentioned.

8. Soil functions addressed by instrument

- no specific soil threats are mentioned.

9. Land cover classes addressed by the instrument

- agricultural areas,

10. Monitoring sites

The project was divided into two phases: the first general screening in which 156 soil samples were collected and analyzed, taking mainly into consideration the soil used for agricultural activity; the second phase took into consideration seven areas where there is a known or at least suspect critical situation.

11. Parameter groups

- Land use

12. Data availability

To be verified

13. Monitoring mechanisms

No replicas of the project are foreseen (to date an update of the work is not expected).

13. Other available information

The Soil Project Report was published in 2015 on the EU Commission website:

https://ec.europa.eu/jrc/en/publication/progetto-di-monitoraggio-ambientale-su-tutto-il-territorio-della-regione-lombardia-progetto-soil

Comments by the assessor:

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT - AOSTA VALLEY LANDSLIDE MONITORING SYSTEM Valle d'Aosta Autonomous Region

SISTEMA REGIONALE DI MONITORAGGIO DEI FENOMENI FRANOSI DELLA REGIONE AUTONOMA VALLE D'AOSTA

1. Brief description of the instrument

The Aosta Valley (Valle d'Aosta) Autonomous Region is the smallest region in Italy, with an area of 3262 km^2. Its territory is located in the highest part of the Alpine chain, thus the relief energy is very high, in fact the altitudes are between 4810 m a.s.l. (the peak of Mont Blanc) and 350 m a.s.l. in the lower part of the Dora Baltea Valley.
These morphological conditions, combined with complex orogenic tectonics, marked by a still active geodynamics, are the main boundary conditions that mark a territory with more than 4000 landslides of various types and sizes;
In the mid-1990s, the first clusters of a regional monitoring network of landslides were built.
After the October 2000 flood, four other large landslides were activated, located in different geological and litho-stratigraphic contexts of the Region.
The volumes of material potentially mobilized varies from 1.2 * 10^6 m^3 to 5 * 10^6 m^3.
The targets threatened by landslides vary from residential areas to infrastructures (railways, roads, highways) and rivers. For all these landslides the scenario of total collapse involves the damming of a stream of water with the resulting dam-break, thus producing an indirect threat to the targets downstream of the landslide accumulation zone.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

- regional monitoring systems,

3. Type of instrument

- regional monitoring systems

4. Status of policy instrument

- In place (since 1996),

5. Territorial coverage

- regional (non-federal state),

6. Sectoral coverage

- cross sectoral

7. Soil threats addressed by instrument

- flooding landslides,

8. Soil functions addressed by instrument

- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- artificial surfaces;
- agricultural areas;
- forests;
- semi-natural areas;
- water bodies.

10. Monitoring sites

The regional landslide monitoring system perform for the control of the landslide hazard on the regional territory, and is articulated into three levels:

1) 1) First level network: it is a monitoring network with *knowledge monitoring* purposes and covers the entire regional territory through the PS Monitoring satellite interferometry technology whose products (ground motion anomaly maps) are processed by the automated ARTEMIS (**A**dvanced **R**egional **TE**rrain **M**otion **I**nSAR **S**creening system) territorial screening procedure, implemented by the regional geological survey. The purpose is to detect new sites to be included in the level 2 or level 3 networks;
2) Second level network: it is a monitoring network with 10 punctual sites for *control monitoring* purposes. It is based on “contact” or “remote” site instrumentation and discontinuous measurements.

3) Third level network: is the continuous monitoring network for emergency monitoring and early warning purposes. It includes 6 sites affected by landslides with volumes higher than 10^6 m3, and foresees the activation of civil protection plans.

The list of the sites belonging to the third level network is available at the following link:
https://www.regione.vda.it/territorio/territorio/rischiidrogeologici/conoscere_territorio_e_rischi/monitoraggio_frane_i.aspx

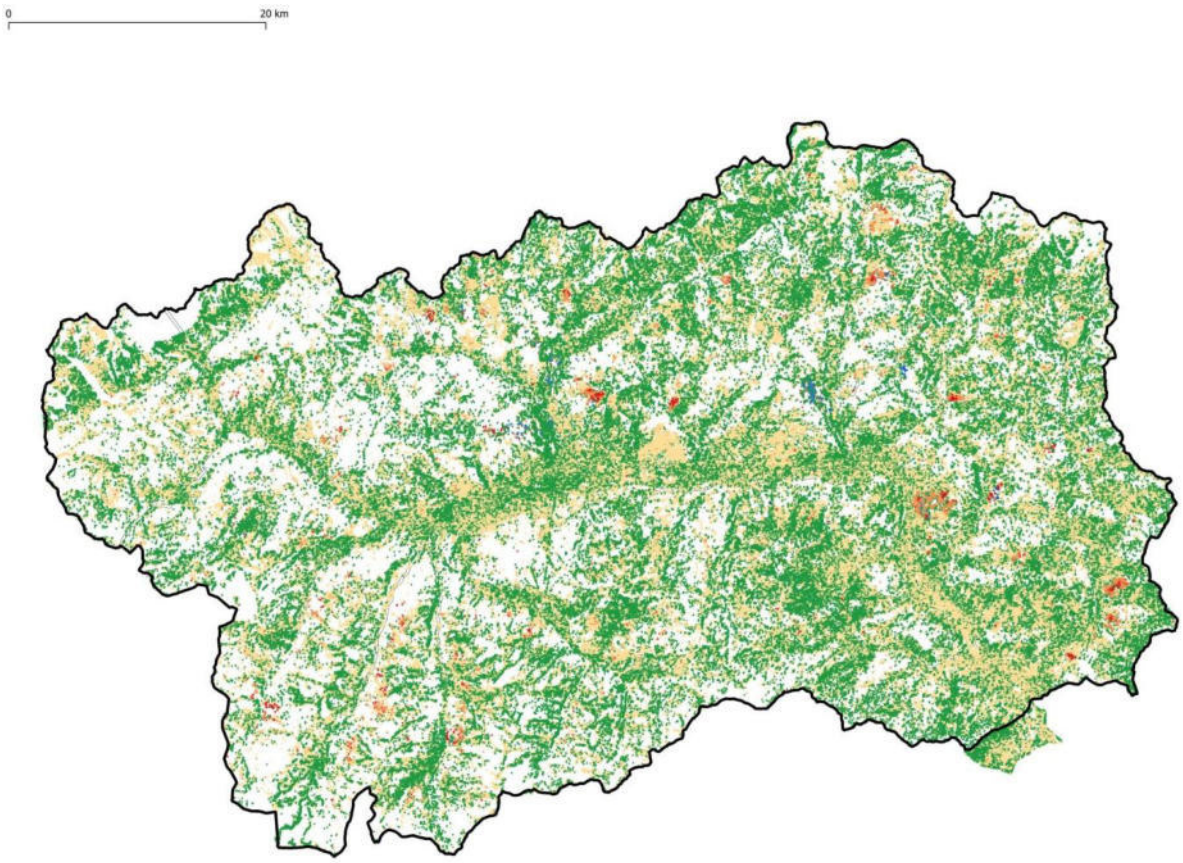

Figura 1 - Layout of the PS InSAR Coverage (Sentinel1 SAR), providing the coverage of the level 1 network

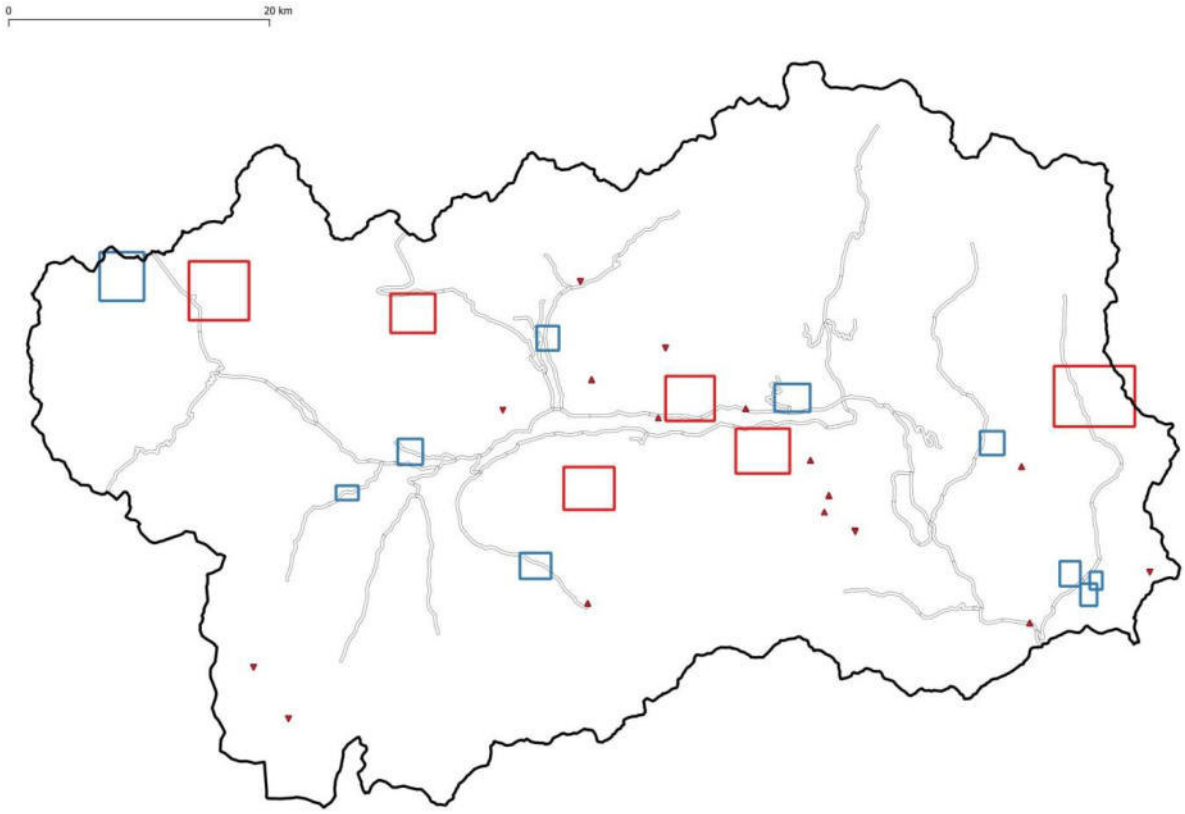

Figure 2 - Layout of the second level network sites (blue rectangles) and of the third level network sites (red rectangles)

11. Parameter groups

- Others
- Climate parameters

12. Data availability

Under the Italian legislative framework, the monitoring data are fully available to all institutions and stakeholders on-demand. Public dissemination is made with periodical reports on the above-mentioned website and, for the most relevant phenomena, (third lever network) monthly bulletins are issued. A public dissemination platform WEBGIS based is under development.

13. Monitoring mechanisms

The Regional monitoring system is made by both extensive and punctual networks. The extensive network include the PSinSAR coverage for PS Monitoring activity.
The Punctual networks, both continuous or discontinuous monitoring, include several types of instruments such as:

- Strain gauges and extensometers;
- Piezometers;

- Multi parametric groundprobes (Differential Monitoring of Stability-DMS);
- Ground Based Interferometric radars Gb-InSAR;
- Robotized Total Stations RTS;
- GNSS-DGPS;
- Meteorological instruments(rain gauges, nivometers, etc.);
- Manual inclinometers;
- Computer vision, both visible and IR wavelengths;

The data collected by the monitoring system are transmitted by the civil protection radio network, or by mobile data network: the choice of the type of data network is strongly conditioned by the orography.
All data are collected at the control center located at the regional geological survey venue in Quart (AO), where an "expert-system" software, processes them and sends SMS alerts to the on-duty personnel and to the Civil Protection Operations Centre when the instrument limits have passed.
The subsequent interpretation of the data aims to detect instrumental anomalies and to validate warnings if necessary. Once an instrumental warning is validated, an alert is sent to the civil protection authorities (Early Warning or Alarm), which activate the civil protection plans.

13. Other available information

The data are classified with the peer-reviewed standard of the “Operative monographies” (Giordan et al., 2018)

Comments by the assessor:

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT - RERCOMF Rercomf - Regional Network for Landslide Movement Control

Rercomf – Rete Regionale Controllo Movimenti Franosi

1. Brief description of the instrument

Arpa Piemonte manages the Regional Landslide Movement Control Network (ReRCoMF), born in the mid-90s and extended, with about 240 monitoring sites, to the entire regional territory. The network includes instrumental control systems installed by municipal and provincial administrations, mountain communities or other bodies and aims to monitor the movement of slow-moving landslides over time.
The network is extensive and the number of sites varies according to new installations, usually as a result of funding from the Piedmont Region. The network is equipped with surface type measuring points (topographic cornerstones, on which the Agency takes readings with total station or with GPS antennas) and deep type (mainly inclinometers and piezometers).
As required by institutional procedures, the instrumental results of the periodic measurement campaigns carried out by Arpa are provided to the municipal administrations in specific technical reports.
The technical and procedural aspects of the Agency's activities in the field of RerCoMF management are specified in the "Disciplinary for the development, management and dissemination of data on monitoring systems on landslides in the regional territory for the purpose of territorial prevention and civil protection ", approved with DGR 16 April 2012, n.18-3690.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

ARPA Piemonte – Agenzia Regionale per la Protezione ambientale della Regione Piemonte (www.arpa.piemonte.it) - [The Environmental Protection Agency of the Piemonte Region]

Regione Piemonte (www.regione.piemonte.it) [Piemonte Region]

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

- In place (since 1994)

5. Territorial coverage

- regional (non-federal state),

6. Sectoral coverage

- cross sectoral

7. Soil threats addressed by instrument

- flooding landslides

8. Soil functions addressed by instrument

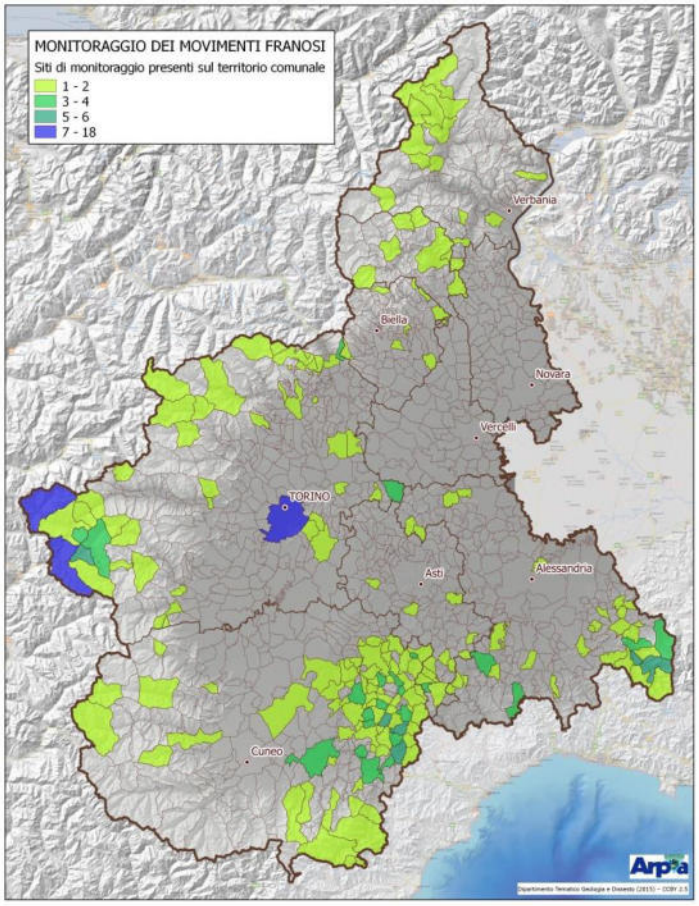
- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- artificial surfaces,
- agricultural areas,
- forests,
- semi-natural areas,

10. Monitoring sites

The list of sites active in the monitoring network can be consulted at the following link: https://www.arpa.piemonte.it/approfondimenti/temi-ambientali/geologia-e-dissesto/fenomenifranosi/rercomf-1/disciplinare-monitoraggio-frane-1/allegato-2
Multiple monitoring sites can affect the same municipal area as explained in the following cartography



11. Parameter groups

- other

12. Data availability

The data are metadocumented and follow the INSPIRE directive. The locations and characteristics of the tools are available on geoportal. The data deriving from monitoring are available on request, as Arpa Piemonte is only the manager and not the owner of the data.
https://webgis.arpa.piemonte.it/geoportale/
As for the municipal administrations, owners of the instrumentation making up the network, the data are available on a dedicated site with restricted access.

13. Monitoring mechanisms

The network is extensive and includes depth and surface control instruments such as inclinometers, strain gauges, piezometers, distance bases, topographic cornerstones, multiparamentric columns, which allow to know the evolution of landslide movements over time.

The number of sites and instruments varies according to new installations, normally following funding from the Piedmont Region and the measurement frequencies are variable: quarterly, quarterly, half-yearly, annual or biennial.

14. Other available information

The Regional Landslide Movement Control Network (ReRCoMF) service is available on the Arpa Geoportal (ReRCoMF) which presents the location of the instruments distinguished by type, the master data, the functionality, the managing body, the technical characteristics of the installation and, where available, a photograph of the monitored site.
https://webgis.arpa.piemonte.it/geoportale/

On the institutional site of ARPA Piemonte, the page dedicated to the Rercomf network can be consulted at the following link:
https://www.arpa.piemonte.it/approfondimenti/temi-ambientali/geologia-e-dissesto/fenomenifranosi/rercomf-1/rercomf

Also on the institutional website, a descriptive poster of the network can be consulted
https://www.arpa.piemonte.it/approfondimenti/temi-ambientali/geologia-e-dissesto/immagini/poster_rercomf
An educational video created specifically for the public that can be viewed at the link below is also available on the Youtube platform
https://youtu.be/2OKJc_fuGIc

Comments by the assessor:

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT - Environmental Soil Quality Monitoring Network

Rete di monitoraggio ambientale dei Suoli del Piemonte

1. Brief description of the instrument

Arpa Piemonte creates a monitoring system for soils in the Piedmont area, designed to provide homogeneous and validated data relating to the main contaminants, to be used as scientific reference support in activities related to the evaluation of soil quality and the application of the regulations concerning the environmental contamination.

Soil monitoring is carried out in monitoring stations distributed throughout the regional territory, in correspondence with the vertices of a systematic network expanded with subsequent levels of depth.

Soil sampling is carried out at fixed depths and for each sample taken, more than 70 contaminants are analyzed between heavy metals, polycyclic aromatic hydrocarbons (PAHs) polychlorinated biphenyls (PCB), dioxins (PCDD) and furans (PCDF) for which values are fixed limit from Legislative Decree 152/06, in addition to non-regulated heavy metals and rare earths.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

ARPA Piemonte – Agenzia Regionale per la Protezione ambientale della Regione Piemonte (www.arpa.piemonte.it) - [The Environmental Protection Agency of the Piemonte Region]

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

- In place (dal 2005 – in progress),

5. Territorial coverage

- regional (non-federal state),

6. Sectoral coverage

Sectors:

- agriculture,
- forestry

7. Soil threats addressed by instrument.

- contamination,

8. Soil functions addressed by instrument ???

- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- platform for human activity,
- storing geological and archeological heritage,
- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,
- semi-natural areas,

10. Monitoring sites

Soil monitoring is carried out at monitoring stations distributed throughout the regional territory.

At present the soils of 600 monitoring stations on systematic mesh have been sampled and analyzed

• 9x9 km: for the soils of the Alpine and hilly areas,

• 4,5x4,5 km: for the soils of the plain

• 3x3 km or 1,5x1,5 km for areas characterized by particular problems related to widespread soil contamination.

The data of the systematic network are integrated with analysis of monitoring stations (currently 400), carried out in the context of other projects carried out by Arpa and sampled and analyzed with the same procedures.

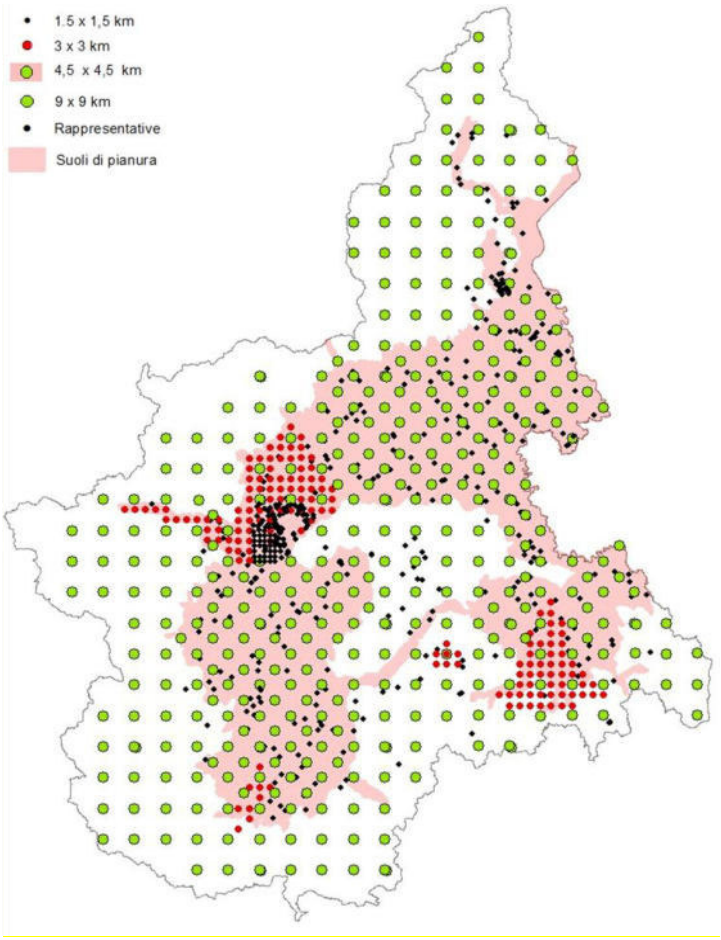

Figure - Location of the stations of the Piedmont Soil Environmental Monitoring Network (data updated in December 2019).

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - Heavy metal concentrations
    - Organic compounds

12. Data availability

The data are disclosed grouped by homogeneous areas of concentration and critical areas of the individual contaminants, obtained through predictive geostatistical models.

13. Monitoring mechanisms

For each sample, contaminants are analyzed for which limit values are set by Legislative Decree 152/06 for sites for public, private and residential green use:

- heavy metals and non-metals (Antimony - Sb, Arsenic - As, Beryllium - Be, Cadmium - Cd, Cobalt - Co, Chrome - Cr, Mercury - Hg, Nickel - Ni, Lead - Pb, Copper - Cu, Selenium - Se, Tin - Sn, Thallium - Tl, Vanadium - V and Zinc - Zn). Extraction in aqua regia and analysis with ICP-MS (Agilent, 7500CE).
- polycyclic aromatic hydrocarbons (IPA - 16 compounds). Extraction through ASE 200 Accelerated Solvent Extractor (Dionex, Sunnyvale, CA, USA). with dichloromethane.
- dioxins and furans (PCDD / DF - 17 congeners). Extraction through ASE 200 Accelerated Solvent Extractor (Dionex, Sunnyvale, CA, USA) with toluene.
- polychlorinated biphenyls (PCB - 30 congeners). Extraction through ASE 200 Accelerated Solvent Extractor (Dionex, Sunnyvale, CA, USA) with toluene.

The following are also analyzed:

- lantanoids or "rare earths" not regulated by Legislative Decree 152/06, but of considerable interest for the assessment of widespread soil contamination: (Cerium - Ce, Dysprosium - Dy, Erbium - Er, Europio - Eu, Gadolinium - Gd, Holmium - Ho, Lanthanum - La, Neodymium - Nd, Praseodymium - Pr, Samario - Sm, Tullio - Tm, Yttrium - Y, and Ytterbium - Yb). Extraction in aqua regia and analysis with ICP-MS (Agilent, 7500CE).
- inorganic compounds not regulated by Legislative Decree 152/06 but necessary for the interpretation of numerous contamination phenomena. Extraction in aqua regia and analysis with ICP-MS (Agilent, 7500CE).

Sampling frequency at least 10 years.

Laboratory analytical determinations carried out on the particle size of less than 2 mm. The concentration of the sample refers to the totality of the dry materials of only the fraction of less than 2 mm without including the fraction of the skeleton 2 cm - 2 mm.

The systematic mesh sampling scheme integrated on successive levels of in-depth analysis was designed to have the highest level of harmonization with other soil monitoring projects carried out at national and European level. In particular, the sampling scheme originated from the points of the systematic network 18 x 18 km of the LUCAS project (European Community, 2003).

13. Other available information

ARPA Piemonte website - The soil environmental monitoring network:
https://www.arpa.piemonte.it/approfondimenti/temi-ambientali/suolo/suolo_rete_monitoraggio

Regional RSA website:
http://relazione.ambiente.piemonte.it/2019/it/territorio/stato/suolo-contaminazione

Publications in ISI scientific journals
Soil quality and landscape metrics as driving factors in a multi-criteria GIS procedure for peri-urban land use planning Urban Forestry & Urban Greening 01/2016; in press. DOI:10.1016/j.ufug.2015.07.004 (*Enrico Borgogno-Mondino*, Gabriele Fabietti, *Franco Ajmone-Marsan*, 2016)

Earth walls as repositories of background levels of soil metal contaminants. Environmental earth sciences 01/2013. (Valter Boero, Gabriele Fabietti, Franco Ajmone-Marsan, 2013).

An appraisal of soil diffuse contamination in an industrial district in northern Italy. Chemosphere 05/2012 (Mattia Biasioli, Gabriele Fabietti, Renzo Barberis e Franco Ajmone Marsan, 2012).

Soil Contamination by Organic and Inorganic Pollutants at the Regional Scale: the Case of Piedmont, Italy. Journal of Soils and Sediments 10 (2), 290-300. (Gabriele Fabietti, Mattia Biasioli, Renzo Barberis e Franco Ajmone Marsan, 2010).

Comments by the assessor:

The use of data from the Soil Environmental Monitoring Network allows to evaluate the presence, origin and intensity of the main forms of widespread contamination of soils in the Piedmont area.
The results of the calculations made it possible to identify two main groups of contaminants that present critical issues in the soils of the Piedmont territory.
A first group is represented by heavy metals and non-metals (Chromium, Nickel, Cobalt, Arsenic, Vanadium and Beryllium) which present critical areas whose origin is mainly due to the chemical composition of the starting material from which the soil originated.
A second group of contaminants is composed of heavy metals (Lead, Copper, Zinc, Antimony, Tin) with critical areas whose origin is attributable in part to the chemical composition of the starting material from which the soil originated and in part to more or less intense phenomena of surface deposition deriving from diffuse anthropogenic contamination.
The results obtained fill a historical lack of data and scientific documentation relating to the characterization and quantification of the widespread contamination of soils in the Piedmont area.
In particular, the data provided represent a fundamental scientific reference support for all activities related to the assessment of the quality of lowland, hilly and alpine soils, the assessment of the quality of the environment in general and territorial planning on a large scale.
The contribution of the monitoring network is also of fundamental importance in the context of investigative activities related to the application of soil regulations, such as Legislative Decree 152/06 and Ministerial Decree August 10, 2012 n. 161.

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Questionnaire permanent monitoring sites

IT –Long-term thermosensitive species monitoring in periglacial soil of Northern Piemonte: Monte Rosa, Val Formazza

National Name: Rete piemontese di monitoraggio delle specie termosensibili in suoli periglaciali

1. Brief description of the instrument

To assess potential impacts of climate change on alpine biota of periglacial soils, a long-term ecological monitoring program was launched in Northern Piemonte.

Plant and Soil mesofauna invertebrates in Nature 2000 habitat of *Carex curvula* heathland and Communities of siliceous scree will be assessed in two study regions near long-term Permafrost Monitoring stations, across altitudinal gradients on more or less moving "cryoclastic systems" with variable granulometry.

The data collected as part of this new monitoring program include environmental conditions temperature in the top soil, meteorological parameters and phenological data of the few flowering plant species.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

ARPA Piemonte – Agenzia Regionale per laPortezione ambientale della Regione Piemonte (www.arpa.piemonte.it)

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

- In pipeline (first tests since 2016)

5. Territorial coverage

- regional (non-federal state),

6. Sectoral coverage
Sites are in snow level and periglacial soils of Pennine and Lepontine Alps sector in Northern Piemonte, across a transect from ca. 2600 mt to 3000 mt.

7. Soil threats addressed by instrument

- Erosion (melting of Permafrost)
- Loss of soil organic matter

8. Soil functions addressed by instrument
- hosting biodiversity pool
- acting as carbon pool

9. Land cover classes addressed by the instrument
- natural areas

10. Monitoring sites
Monitoring sites were established in 2016 in the Alta Valsesia Park (Nature 2000 Special Area of Conservation "Monte Rosa") and in Sabbioni Glacial area in high Val Formazza (Nature 2000 Special Protection Area " Alta Val Formazza"). In Monte Rosa the site is located at 3000 m (Passo dei Salati), in Sabbioni Glacial area at 2600 mt (Hosand Glacier)

11. Parameter groups

- Soil biodiversity
- Climate parameters
- Soil temperature

12. Data availability
Currently not avilable on line

13. Monitoring mechanisms
Investigated parameters include:
- Site climate conditions, soil temperature
- Botanical-Vegetation Studies (phitosociological and phenological sampling)
- Soil mesofauna
- Cryosphere: permafrost, geomorphodynamics

14. Other available information

"Clima e biodiversità. Esperienze di monitoraggio in ambiente alpino"
http://www.arpa.piemonte.it/pubblicazioni-2/pubblicazioni-anno-2012/clima-e-biodiversita

“Monitoraggio della biodiversità in ambito alpino: strategie e prospettive di armonizzazione”
2° Report of SAPA Network-System of the Italian Alpine Protected Areas, 2019, pp.149-151
http://www.areeprotette-sapa.it/wp-content/uploads/2019/10/2%C2%B0-REPORT-RETE-SAPA.pdf

Comments by the assessor:

The program is supported in Monte Rosa, by Alta Valsesia regional Park and is in collaboration with “Alpine Soil and Snow Laboratory” of University of Torino (DISAFA) which is settled nearby in the Mosso Research Centre.
ARPA Piemonte also manage in this area a set of 3 meteorological survey system across a gradient from 1500 to 4400 mt on Mount Rosa.

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Questionnaire permanent monitoring sites

IT – Permafrost long-term monitoring network in Piedmont Alps

National Name: Rete piemontese di monitoraggio del permafrost e della temperatura superficiale del terreno (*GST – Ground Surface Temperature*)

1. Brief description of the instrument

To assess potential impacts of climate change on bedrock, debris and soils, a long-term permafrost monitoring network has been established in Piedmont Alps, thanks to a European Alpine Space Project "PermaNET – permafrost long-term monitoring network" (2008-2011). Starting from this project, many activities on thermal monitoring of the ground have been implemented by Arpa Plemonte until nowadays. The permafrost monitoring is characterised by chains of thermal sensor in vertical boreholes (5 to 100 m deep), GST monitoring is characterised by thermal sensors put in the ground, water or ice (2 to 100 cm deep).
The main goals of this monitoring in Piedmont Alps, are:

- to evaluate the thermal effect on the ground in the periglacial environment of the atmospheric variations in relation to climate change;
- to analyse relationships between permafrost degradation and slope instability, for land/infrastructures and natural risks (floods, landslides and debris flows) management in high mountain areas;
- to study the soil and biodiversity evolution in deglaciated and periglacial areas;
- to assess the water quantity and quality in high mountain catchments, interested by permafrost degradation and melting ice from permafrost

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

ARPA Piemonte – Agenzia Regionale per la Protezione Ambientale della Regione Piemonte (www.arpa.piemonte.it) [*Regional Agency for Environmental Protection of Piemonte*]

3. Type of instrument

- regional monitoring systems (harmonized with the International monitoring network)

4. Status of policy instrument

- in place (since 2009, implemented year by year)
- in pipeline (since 2009, implemented year by year)

5. Territorial coverage

- regional (non-federal state)

6. Sectoral coverage

- cross sectoral (natural risks, water and land/infrastructures management, soil and biodiversity evaluation, assessment of climate change effects on alpine cryosphere)

7. Soil threats addressed by instrument

- erosion (thawing permafrost)
- landslides (thawing permafrost)
- contamination (by water from ice melting in permafrost)
- loss of soil organic matter (due to thermal disequilibrium)
- loss of soil biodiversity (due to thermal disequilibrium)

8. Soil functions addressed by instrument

- storing, filtering, transforming nutrients or water
- hosting biodiversity pool
- platform for human activity
- storing geological and archaeological heritage

9. Land cover classes addressed by the instrument

- natural and semi-natural areas
- wetlands
- water bodies

10. Monitoring sites

Permafrost monitoring stations have been installed in 5 points of Piedmont Alps (2 in Southern Cottian Alps, at an altitude of 2500 and 2870 m asl respectively; 1 in Northern Cottian Alps, at 2985 m asl of altitude; 2 in Pennine Alps, at an altitude of 2870 and 3020 m asl respectively).
GST monitoring sites have been installed in the whole Piedmont Alps, from Ligurian to Lepontine Alps, from 1900 m to over 3500 m asl of altitude, in several geologic-geomorphologic contests (debris, rocks, soils, grasslands, caves, rock-walls, etc.).

Map of monitoring sites to be found here:

- http://www.arpa.piemonte.it/approfondimenti/temi-ambientali/geologia-e-dissesto/bancadatiged/criosfera-e-permafrost

11. Parameter groups

In all sites:

- Site characteristics (soil type, etc.)
- Climate parameters
    - Soil temperature

In some cases (integrating multi-sectoral activities):

- Soil chemistry
  - pH-value
  - Heavy metal concentrations
  - Organic compounds
- Soil carbon
- Soil biodiversity
- Soil erosion

12. Data availability

Free and validated data/graphics are available here:

- http://www.arpa.piemonte.it/approfondimenti/temi-ambientali/geologia-e-dissesto/permafrost/monitoraggio-permafrost

Further information and other not yet published data are available on-demande (by e-mail to: geologico@arpa.piemonte.it)

13. Monitoring mechanisms

The permafrost and GST monitoring is a thermal monitoring of geo-materials (soil, debris and rock). In order to evaluate the climate change effect on the thermal equilibrium of the ground, a meteorological-climate monitoring is always associated. In some specific sites, other monitoring activities, studies and analyses are carried on in order to evaluate the relationships among permafrost degradation and natural risks, water quality, ecosystems and soils conditions, and cryosphere evolution. So, in these specific cases, the thermal monitoring of geo-materials is associated to botanical-vegetation studies (phito-sociological and phenological sampling), soil meso-fauna analysis, geotechnical monitoring, water-snow-ice quantity/quality monitoring, periglacial processes monitoring (thermal state and morpho-dynamics).

14. Other available information

Other information on the permafrost-GST monitoring and related activities are available on the Annual Regional Report on Environment, published yearly by Arpa Piemonte and Regione Piemonte with specific focus (in Italian):

- relazione.ambiente.piemonte.it/2016/it/clima/impatti/permafrost
- relazione.ambiente.piemonte.it/2017/it/clima/impatti/permafrost
- relazione.ambiente.piemonte.it/2018/it/clima/impatti/permafrost
- relazione.ambiente.piemonte.it/2019/it/clima/impatti/permafrost

Some information about this topic in English are available here:

- http://www.arpa.piemonte.it/approfondimenti/temi-ambientali/geologia-e-dissesto/progetti-geologia-e-dissesto/ENprevriskhautemontagne201d
- https://youtu.be/bzXve9BI5jY

Comments by the assessor:

Due to inter-sectorial approach linked to the permafrost and thermal ground monitoring, several Institutions supported the activities and most of them are carried on with their collaboration.
In the Monte Rosa area, the soil and biodiversity evaluation is supported by Alta Valsesia regional Park and is implemented in collaboration with “Alpine Soil and Snow Laboratory” of University of Torino (DISAFA) which is settled nearby in the Mosso Research Centre (2850 m asl of altitude). In the same area, the analysis of the relationships between permafrost and infrastructures is supported by Monterosa 2000 srl (manager of cable ways and sky resort).
Geomorphologic dynamic in periglacial areas is monitored in collaboration with Universities of Pisa (Earth Science Dept.) and of Insubria (Theoretical and Applied Sciences Dept.), and with Arpa of the Regione Valle d’Aosta.
The water quality and its relationship with permafrost degradation are analysed in collaboration with CNR-IRSA (Institute for Water Researches) of Verbania and in the framework of a European project Italy-Switzerland “ReservAQUA” started in 2019 ant still ongoing.
The ice cave monitoring is carried on in collaboration with Paleo-Lab of Polytechnics of Torino, with de DIATI (Engineering of Environment, Land and Infrastructures Dept.) of Polytechnics of Torino, and with University of Milano Bicocca (EuroCold Lab).

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Questionnaire permanent monitoring sites

IT – Tetto Frati Long-term Experiment

National Name: Prova storica di Tetto Frati

1. Brief description of the instrument

The experimental platform compares 38 different cropping systems, all typical of the Northwestern Po plain dairy farms. Four rotations (maize for grain with crop residue return, entirely harvested maize for silage, Italian ryegrass-maize for silage double cropping, maize for silage-grass meadow 6 years rotation) are compared at 9 fertilisation types and levels (0, 100, 170, 250 and 350 kg ha^{-1} of N as urea, 170 and 250 kg $ha^{-1}$of N as farmyard manure, 170 and 250 kg $ha^{-1}$of N as bovine liquid manure, plus two systems at a single N rate of 170 kg ha^{-1}, maize for silage-lucerne meadow 6 years rotation and permanent meadow).
Plots are 75 m3, organized in a randomized block design. The experiment was started in 1992 and treatments have been modified only slightly since then. It is focused on studying environmental effects of fertilization under the Nitrates Directive and Derogation schemes, but also long-term SOM evolution and the C and N interaction.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

The platform is managed by the University of Torino, Italy, Dept. of Agricultural, Forest and Food Sciences (www.disafa.unito.it).

Responsible persons: Laura Zavattaro (laura.zavattaro@unito.it) and Carlo Grignani (carlo.grignani@unito.it)

3. Type of instrument

- international monitoring systems,
- national monitoring systems,
- regional monitoring systems,

The platform was included in European projects (ExpeEr, Catch-C), national projects (IC-FAR) and regional projects (several, currently one aimed at monitoring the Derogation to the Nitrates Directive fertilisation scheme)

4. Status of policy instrument

- In place since 1992

5. Territorial coverage

- national (MS level),
- regional (federal state or non-federal state),
- The site is representative of the conditions of the Po plain

6. Sectoral coverage

- agriculture,

7. Soil threats addressed by instrument

The European Soil Thematic Strategy identifies 8 soil threats. These include: erosion, flooding and landslides, loss of soil organic matter, salinization, contamination, compaction, soil sealing and loss of soil biodiversity. Please keep the answers as they are – i.e. don't add or rewrite the answers.

Which threats are addressed **explicitly**, i.e. the monitoring scheme explicitly aims to address the threat (this is stated in its scope, objectives, or the activities and mechanisms it includes)? DELETE answers that are not relevant.

- loss of soil organic matter,
- contamination, → excessive N and P fertilisation in particular
- loss of soil biodiversity,
- No specific soil threats are mentioned.

8. Soil functions addressed by instrument

Which soil functions does the monitoring scheme address – i.e. provide support for, either explicitly or implicitly. (Explicitly means that addressing the soil function is stated in its scope, objectives, or the activities and mechanisms it includes; implicitly means that the instrument may have implications for the soil function, but this is not explicitly stated in the text). DELETE answers that are not relevant.

- biomass production, → EXPLICITLY
- storing, filtering, transforming nutrients or water, → EXPLICITLY
- hosting biodiversity pool, → IMPLICITLY
- providing raw materials, → IMPLICITLY, if biomass is used to produce energy instead of as feed

- acting as carbon pool, → EXPLICITLY

9. Land cover classes addressed by the instrument

Here we identify what types of land covers are affected by the instrument. These are Corine land cover classes. The land uses in the monitoring might not correspond directly to these broad classes. DELETE not relevant ones.

- agricultural areas,
- semi-natural areas,

10. Monitoring sites

Tetto Frati, Carmagnola, Regione Piemonte, Italy

Latitude 44° 53' N, longitude 7° 41' E, altitude 232 m a.s.l.

11. Parameter groups

- Site characteristics (soil type etc.) → Typic Ustifluvent, loam, calcareous
- Soil chemistry
  - pH-value → 8.1
  - Heavy metal concentrations
  - Organic compounds
- Soil carbon → monitored every 3 years 0-100 cm
- Soil biodiversity
- Soil erosion → not relevant
- Climate parameters → monitored
  - Soil temperature → monitored

12. Data availability

Data are available upon request. Meta-information is available. It is not yet in line with INSPIRE

13. Monitoring mechanisms

Yield, NPK content of yield and fertilisation are measured every year at all plots. The SOM content is measured at all plots every 3 years in the 0-30, 30-60 and 60-90 cm layers. Soil mineral N content is measured twice a year in a subset of 22 treatments since 2011. Data from previous sampling campaigns are also available.
The site was part of the networks set by the project ExpeER at a EU level, and if IC-FAR at a national level. It has been proposed for several Infrastructure EU project (not funded).

13. Other available information

Grignani C., Zavattaro L.*, Sacco D., Monaco S., 2007. Production, Nitrogen and Carbon balance of maize-based forage systems. European Journal of Agronomy 26: 442-453. DOI 10.1016/j.eja.2007.01.005

Bertora C.*, Zavattaro L., Sacco D., Monaco S., Grignani C., 2009. Soil organic matter dynamics and losses in manured maize-based forage systems. Eur. J. Agron. 30 (3): 177-186. DOI 10.1016/j.eja.2008.09.006

Borda T.*, Celi L., Zavattaro L., Sacco D., Barberis E., 2011. Effect of agronomic management on risk of suspended solids and phosphorus losses from soil to waters. J. Soil Sediment 11: 440-451. DOI 10.1007/s11368-010-0327-y

Zavattaro L.*, Monaco, S., Sacco D., Grignani C., 2012. Options to reduce N loss from maize in intensive cropping systems in Northern Italy. Agric. Ecosys. Environ. 147: 24-35. DOI 10.1016/j.agee.2011.05.020

Zavattaro L.*, Assandri D., Grignani C., 2016. Achieving legislation requirements with different nitrogen fertilization strategies: results from a long term experiment. Eur. J. Agron. 77: 199-208. DOI 10.1016/j.eja.2016.02.004

Sandén T.*, Zavattaro L., Spiegel H., Grignani C., Sandén H., Baumgarten A., Tiirola M., Mikkonen A., 2019. Out of sight: Profiling soil characteristics, nutrients and bacterial communities affected by organic amendments down to one meter in a long-term maize experiment. Appl. Soil Ecol. 134: 54-63. DOI 10.1016/j.apsoil.2018.10.017

Xu H.*, Vandecasteele B., Zavattaro L., Sacco D., Wendland M., Boeckx P, Haesaert G., Sleutel S., 2019. Maize root-derived C in soil and the role of physical protection on its relative stability over shoot-derived C. Eur. J. Soil Sci. 70(5): 935-946. DOI 10.1111/ejss.12792

Harrison M.*, Zavattaro L., Roggero P.P., 2019. Simple, efficient and robust techniques for automatic multi-objective function parameterisation: case studies of local and global optimisation using APSIM. Environ. Modell. Softw. 117: 109-133. DOI 10.1016/j.envsoft.2019.03.010

Comments by the assessor:

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT- regione Piemonte-I.P.L.A.s.p.a.: RETE DI MONITORAGGIO PEDOCLIMATICA DEL TARTUFO BIANCO IN PIEMONTE

1. Brief description of the instrument

Pedoclimatic characterization and production performance of 4 truffles of Tuber magnatum typical of the Piedmont hills, on the basis of a multi-annual monitoring. The comparison of the collected and processed data provides a useful framework to better understand how the variation of the main physical and chemical parameters of the soil of the investigated ecosystems, in relation to the hypotheses of climate change, can influence the truffle fructification.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

I.P.L.A. spa - www.ipla.org

3. Type of instrument

- regional monitoring systems,
- instrument with direct impact on soil.

4. Status of policy instrument

- In place (10 yrs),

5. Territorial coverage

- sub-regional.

6. Sectoral coverage

Sectors:

- agriculture,
- forestry,

7. Soil threats addressed by instrument

- loss of soil biodiversity,

8. Soil functions addressed by instrument

- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,

9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,

10. Monitoring sites

The monitoring sites (Mombercelli, Viarigi, Ceva, Aramengo) are located in the southern portion of the AC perimeter in the Langhe subregion originated by sediments from an ancient sea basin, the Piedmontese Tertiary Basin, which were later raised by a sudden tectonic movement that brought them to current levels. Within this broad area are mainly Marls, Sands or Sandstones.

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
- Soil carbon
- Soil biodiversity
- Soil erosion
- Climate parameters
    - Soil temperature

12. Data availability

Are data free available or restricted? Restricted

Is meta-information available? No

Is it in line with INSPIRE? No

13. Monitoring mechanisms

- What types of monitoring is included; what parameters (broad categories are sufficient) are measured and for what purpose, with what frequency?

  The monitoring provides data on hourly rate used to calculate the soil water balance and soil temperature and humidity records which are related to ecosystem soil parameters and truffle ecology and production.

- Any other aspects of the monitoring scheme that you think are very important to understand its relevance for soil protection, for example, if the scheme helps to establish harmonised monitoring data at international or national level, or on the other hand if it is a private initiative, what its limitations might be, or if it could be expanded to cover a wider area:

  The monitored data are a ten years record set which allows evaluation on climate change based on variation of soil water balance, soil temperature and soil humidity, besides all the other climatic data (air temperature, rainfall, radiation, ecc.). The monitored area could be expanded in order to realize a territorial spatialization, at least of the Langhe subregion.

13. Other available information

The complete report (in italian)of ten years monitoring is property of the Forestry Dept. of the Piedmont Region which must authorize its use and spreading.

A scientific paper (in english) is in course of publication under the following title:

Influence of pedoclimatic factors on the fructification of Tuber magnatum Pico in four Piedmontese truffles (Fabio Petrella, Cristina Grieco, Mario Palenzona) - International Journal of Scientific Research in Research Paper . Multidisciplinary Studies, E-ISSN: 2454-9312, Vol., Issue., pp., (2020) P-ISSN: 2454-6143

Comments by the assessor:

The broad data set of 10 years record and all the elaboration done till now need to be implemented on the following levels:

- increase of number of monitoring sites on a subregional scale
- spread of results by on-line and download facilities
- use of results to wider purposes such as evaluation of climate change consequences on soil biodiversity and water balance.

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Questionnaire permanent monitoring sites

IT – ARPA-Veneto – ORGANIC COMPOUND MONITORING SCHEME

ARPAV-organici

1. Brief description of the instrument

It is a program aimed at monitoring organic compounds, together with heavy metals, to assess diffuse contamination status of soil, together with information on impact of potential pressures in order to to gather information on trends.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

The Environmental Protection Agency of the Veneto Region (ARPAV https://www.arpa.veneto.it/) is the only institution responsible for the monitoring. There is no regulation at national or regional level, monitoring is carried out on ARPAV initiative.

3. Type of instrument

- regional monitoring systems

4. Status of policy instrument

No policy at national or regional level

5. Territorial coverage

- regional (federal state or non-federal state)

6. Sectoral coverage

Sectors:

- cross sectoral.

7. Soil threats addressed by instrument

- contamination

8. Soil functions addressed by instrument

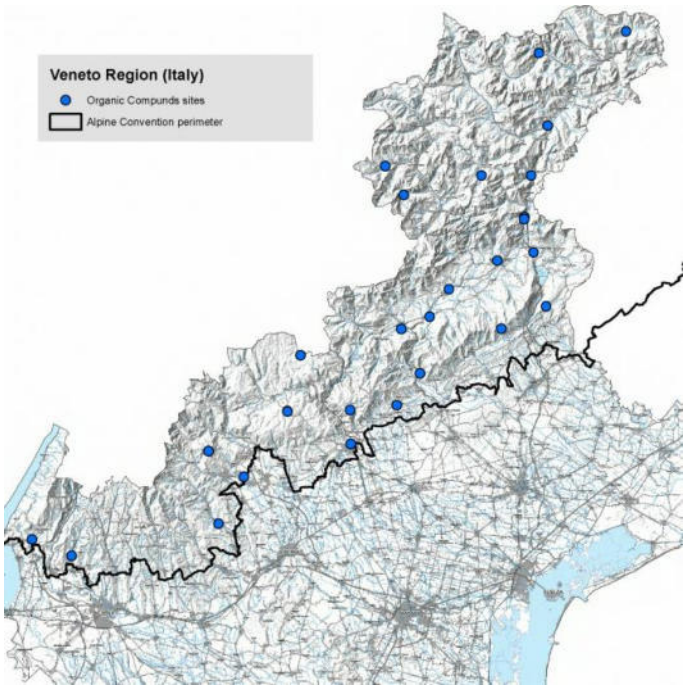
- biomass production,
- storing, filtering, transforming nutrients or water,
- platform for human activity,
- providing raw materials,

9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,
- semi-natural areas,

10. Monitoring sites

Monitoring is worked out on 26 sites within the Alpine Convention territory, positioned not regularly in mountain areas (approximately one site every 20kmx20km).
An overview of sites is available on the map.



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Organic compounds
- Soil carbon

12. Data availability

Site data are restricted. Report on results is available in the web. Meta information is available. Not in line with INSPIRE (national projection system).

13. Monitoring mechanisms

Organic compound monitoring has started in 2010 and the aim is to assess diffuse contamination status of soil and to collect information on impact of potential pressures, monitoring their trends over time.
Sampling: planned every 10 years.
Parameters: Dioxins, Furans (PCDD/Fs), PCBs, PAHs, together with heavy metals (Sb, As, Be, Cd, Co, Cr, Hg, Ni, Pb, Cu, Se, Sn, V, Zn).
Since no regulation at national or regional level exists and monitoring is worked out as a Regional Environmental Protection Agency initiative, there are no prefixed schemes and no harmonising with other regional initiatives.

13. Other available information

Report on organic compounds at:
https://www.arpa.veneto.it/temi-ambientali/suolo/file-e-allegati/documenti/rete-di-monitoraggio/Microinquinanti_organici_suoli_2010-2016.pdf

Comments by the assessor:

Need for assessment of heavy metal background values is due to national legislation on reuse of excavated soils and rocks: National Environmental Code of 2006 (DL n. 152/2006) and Presidential Decree DPR 120/2017. No other legal obligation exists at national/regional level to set up a soil monitoring program.

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – ARPA-Veneto – Heavy Metals monitoring scheme

ARPAV-metalli

1. Brief description of the instrument

It is a study aimed at determining heavy metal background values, mainly analyzing soil samples collected, not on a regular grid, by soil surveys carried out on the whole regional territory.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

The Environmental Protection Agency of the Veneto Region (ARPAV https://www.arpa.veneto.it/) is the only institution responsible for the monitoring. There is no regulation at national or regional level, monitoring is carried out on ARPAV initiative.

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

No policy at national or regional level

5. Territorial coverage

- regional (federal state or non-federal state)

6. Sectoral coverage

Sectors:

- cross sectoral.

7. Soil threats addressed by instrument

- contamination,

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- platform for human activity,
- providing raw materials,

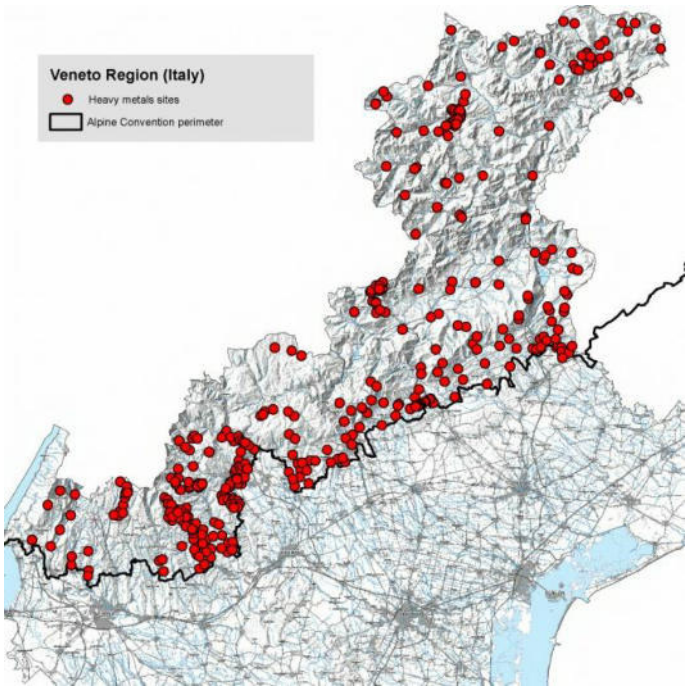
9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,
- semi-natural areas,

10. Monitoring sites

Sites were selected among those described and sampled within soil surveys at 1:250,000 and 1:50,000 scale (more than 3,500 soil profiles widespread on the whole regional territory). Among these, approximately 400 sites, are within the Alpine Convention territory. Sites are not set on a regular grid, but they were chosen as representatives of described soil types, aiming at determining their heavy metal background values.

An overview of sites is available on the map.



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
- Soil carbon

12. Data availability

Site data are restricted, but areal data are available. Report available in the web. Meta information is available. Not in line with INSPIRE (national projection system).

13. Monitoring mechanisms

Within the Alpine Convention territory approximately 400 sites have been analyzed, selected among described soil profiles (in the whole region more than 3.000 soil profiles); they were selected as representative of main soil types and are aimed at determining heavy metal background values, useful for remediation and for reuse of excavated soil.
Soil profiles have been sampled since years '90s within soil survey regional programs.
Sites are not planned to be resampled.
Parameters: Sb, As, Be, Cd, Co, Cr, Hg, Ni, Pb, Cu, Se, Sn, V, Zn.

13. Other available information

Map of background values for heavy metals are available at geoportal:
http://geomap.arpa.veneto.it/layers/geonode%3Ametmetalloidi

Report on heavy metals background values:
https://www.arpa.veneto.it/arpavinforma/pubblicazioni/metalli-e-metalloidi-nei-suoli-del-veneto-definizione-dei-valori-di-fondo.-edizione-2019

Comments by the assessor:

Need for assessment of heavy metal background values is due to national legislation on reuse of excavated soils and rocks: National Environmental Code of 2006 (DL n. 152/2006) and Presidential Decree DPR 120/2017. No other legal obligation exists at national/regional level to set up a soil monitoring program.

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – ARPA-Veneto – Soil Biological Quality

ARPAV-QBS – Qualità Biologica del Suolo

1. Brief description of the instrument

The program is aimed at monitoring biological quality of soil by detecting microarthropods presence and their edaphic forms, following a methodology that leads to assess a soil biological quality index named QBS-ar.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

The Environmental Protection Agency of the Veneto Region (ARPAV https://www.arpa.veneto.it/) is the only institution responsible for the monitoring. There is no regulation at national or regional level, monitoring is carried out on ARPAV initiative.

3. Type of instrument

- regional monitoring systems,

4. Status of policy instrument

No policy at national or regional level

5. Territorial coverage

- regional (federal state or non-federal state),

6. Sectoral coverage

Sectors:

- cross sectoral.

7. Soil threats addressed by instrument

- loss of soil biodiversity,
- loss of soil organic matter,
- compaction,

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- acting as carbon pool,

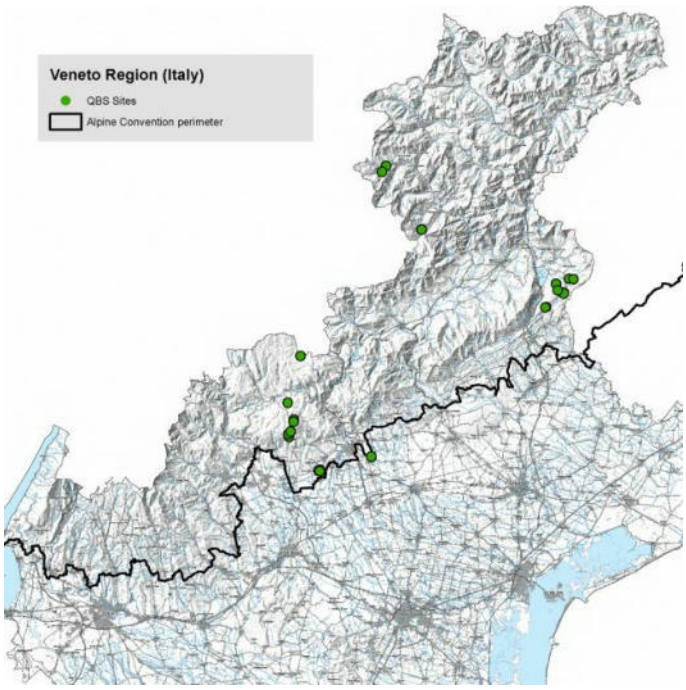
9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,
- semi-natural areas,

10. Monitoring sites

Approximately 16 sites within the Alpine Convention territory, not on a regular grid, selected on the basis of great group of soil types, land use and lithology.

An overview of sites is available on the map.



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
- Soil carbon
- Soil biodiversity

12. Data availability

Site data are restricted. Report on results is available on the web. Meta information is available. Not in line with INSPIRE (national projection system).

13. Monitoring mechanisms

Approximately 16 sites within the Alpine Convention territory.
Sampled yearly since 2018.
Parameters: pH, SOC, carbonates, soil texture and bulk density are measured.
QBS-ar is a methodology applied in different regions in Italy and there's a national working group for metodology harmonizing although there is no harmonized scheme among them up to now.

13. Other available information

Report on biological quality index of soils in the Veneto Region:

https://www.arpa.veneto.it/temi-ambientali/suolo/file-e-allegati/documenti/rete-di-monitoraggio/MONITORAGGIO_QBS_RISULTATI_ARPAV_2019.pdf

QBS-ar methodology description:
https://www.sciencedirect.com/science/article/abs/pii/S1470160X17307422

Comments by the assessor:

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – ARPA- FRIULI VG – ORGANIC AND INORGANIC SUBSTANCES MONITORING SCHEME

ARPA FVG – "*indagine per la valutazione dei valori di riferimento per una o più sostanze nei suoli regionali*"

1. Brief description of the instrument

a) aim and scope of the scheme:
monitoring of inorganic and organic sustances in soils. Assessment of the background content (concentration) and values in regional soils. Possible repetition of the checks over time to evaluate the trends of the contents detected;
b) links to policy objectives and other policy instruments
National Environmental Laws of 2006 (DLgs n. 152/2006) and Presidential Decree DPR 120/2017;
c) parameters of interest of the scheme
the scheme (substantially) focuses on heavy metals (inorganic substances) and Persistent Organic Pollutants - POP's (organic substances);

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

The environmental protection agency of the Friuli VG Region (ARPA FVG https://www.arpa.fvg.it/) is the institution responsible for the monitoring scheme. Soil monitoring is currently not required by any national or regional regulation

However, all activities of ARPA FVG are shared with the Friuli VG Region – Direzione Centrale Difesa dell'Ambiente, Energia e Sviluppo Sostenibile (https://www.regione.fvg.it/rafvg/cms/RAFVG/ambiente-territorio/).

3. Type of instrument

regional monitoring systems,

4. Status of policy instrument

No policy instrument at the moment

5. Territorial coverage

regional

6. Sectoral coverage

cross sectoral

7. Soil threats addressed by instrument

contamination,

8. Soil functions addressed by instrument

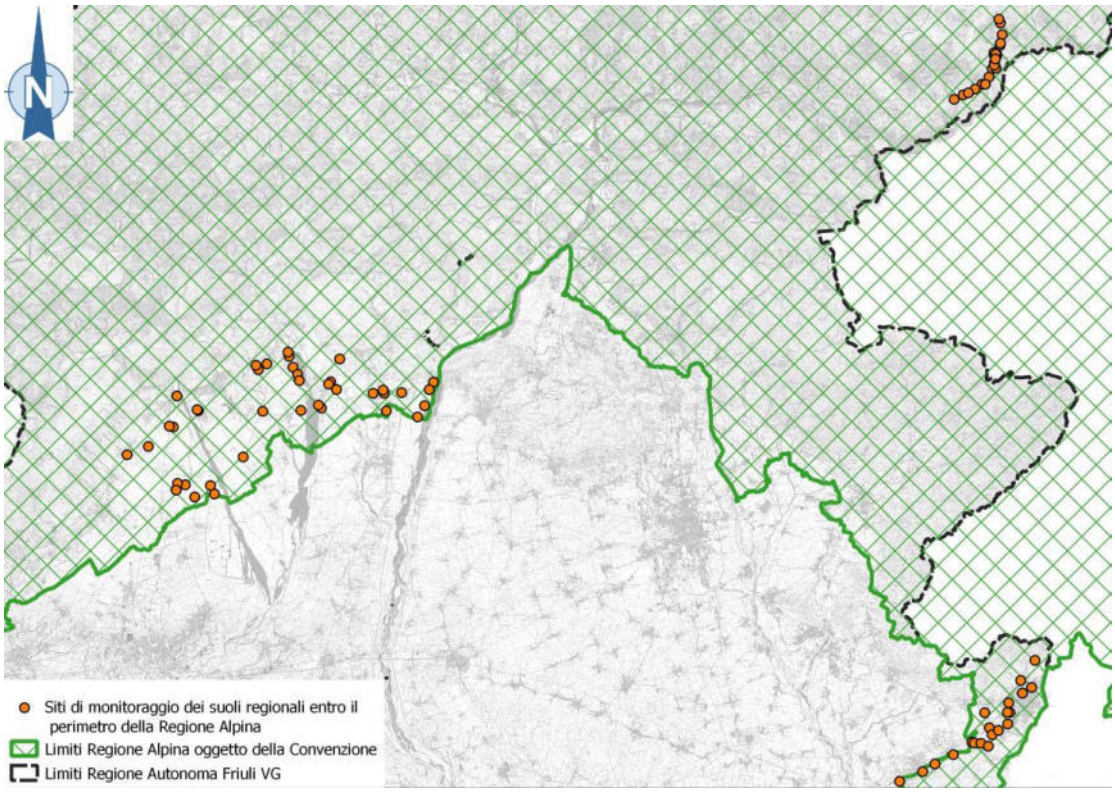
- storing, filtering, transforming nutrients or water,
- platform for human activity,
- providing raw materials,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,
- semi-natural areas.

10. Monitoring sites

Monitoring is carried out in correspondence of sites located mainly in the regional plain (now about 350 monitoring sites). Surveys were not carried out on all monitoring sites. Further monitoring sites will concern other parts of the regional territory. The assessment of the quality of regional soils is ongoing. Monitoring sites were chosen as representatives of described soil types. Monitoring sites were chosen in correspondence with public property areas. Monitoring sites are not arranged on a regular grid.
Currently there are about 80 sites among them located in the Alpine Convention territory. The current monitoring sites are shown on the next map.



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
  - Organic compounds
- Soil carbon

12. Data availability

Site data and Report are not avalaible on the web. Meta-information is currently not available. Not in in line with INSPIRE.

13. Monitoring mechanisms

Inorganic substances monitoring has started in 2016. The monitoring aims to assess the state of diffuse soil contamination and to collect information on impact of potential pressures.
Measured parameters are: Sb, As, Be, Cd, Co, Cr, Hg, Ni, Pb, Cu, Se, Sn, Tl, V, Zn, Al, Fe, Mn.
At some of the selected monitoring sites: Dioxins, Furans (PCDD/Fs), PCBs, PAHs
According to the needs and indications, (at least) some monitoring sites may be resampled.

The scheme can establish harmonised monitoring data (at least) at national level; the monitoring scheme aims to affect the entire regional territory.

13. Other available information

No link(s) to publications and to the websites which describe the monitoring mechanism. No Other links to information that is relevant and useful to illustrate the monitoring scheme and its implementation.

Comments by the assessor:

Closed-ended questions do not always include an appropriate answer.

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Soil Protection Working Group

Questionnaire permanent monitoring sites

IT – ARPA FVG – Soil Biological Quality

ARPA FVG – QBSar (Soil Biological Quality arthropod)

1. Brief description of the instrument

Pilot study on the biological quality of the soil using the QBS method. The study was aimed at verifying the biological response of the soils in areas with different intended uses envisaged in the PRGC, by monitoring the edaphic microarthropod communities. The areas of interest included SIC, ZPS, nature reserves, uncultivated areas, pastures located throughout the regional territory, including the Alpine area of Friuli Venezia Giulia Region.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

The Environmental Protection Agency of the Friuli Venezia Giulia Region (ARPA FVG https://www.arpa.fvg.it/) is the only institution responsible for the monitoring. There is no regulation at national or regional level, monitoring is carried out on ARPA FVG initiative.

3. Type of instrument

Please choose the type of monitoring scheme, DELETE those which do not apply.

- national monitoring systems.

4. Status of policy instrument

- in pipeline at national level.

5. Territorial coverage

- regional (federal state or non-federal state).

6. Sectoral coverage

Sectors:

- cross sectoral.

7. Soil threats addressed by instrument

- loss of soil organic matter,
- loss of soil biodiversity,
- compaction.

8. Soil functions addressed by instrument

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- storing geological and archeological heritage.

9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,
- semi-natural areas.

10. Monitoring sites

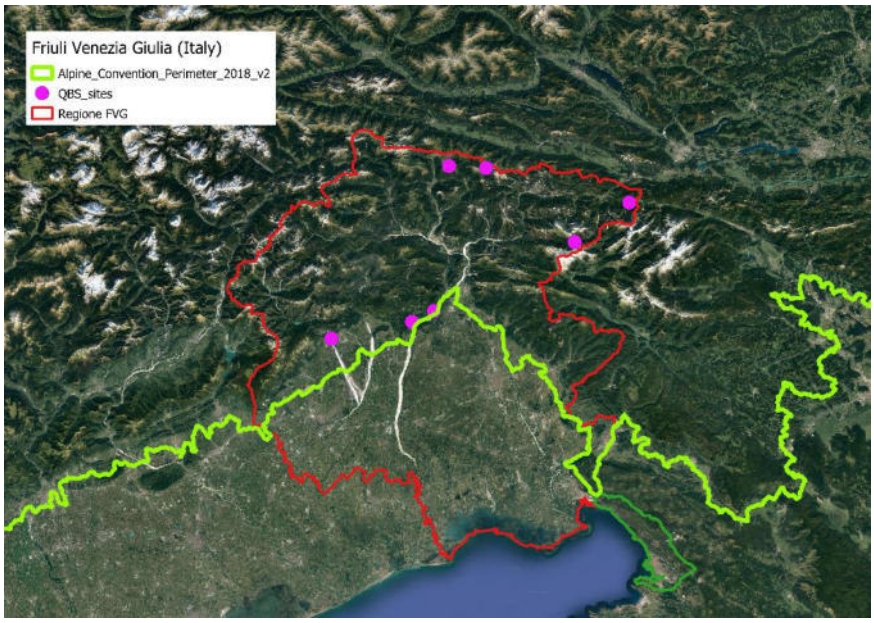
Within the perimeter of the Alpine Convention, there are about 7 monitoring sites selected on the basis of soil lithology, protected areas and land use in public areas.

Some information is given in the following table:

Site	**Comune**	**Stratigraphic lithology unit**	**Land use and area procteted**	**WGS84/UTM zone 33N x**	**WGS84/UTM zone 33N y**
PA001	Paularo	Storage of mixed platforms	moorland	361098	5158444
FU001	Tarvisio	Morainic deposits of the mountain sector and the morainic	moorland	398471	5149438

		amphitheatre of the Tagliamento			
SRIF	Maniago	Alluvial sediments of the mountain, plain and coastal sectors	Steady meadows	320684	5113878
LDM2	Ligosullo	Deposits of alluvial conoids passing through alluvial plain with local sabkha conditions	Alpine, ZPS	351426	5158979
PINZ	Pinzano al Tagliamento	Epibatial, deltitic and alluvial conoid deposits with lake episodes	pedemontana	341730	5118277
QB008	Forgaria nel Friuli	Recent and current ground debris	Natural reserve	347478	5118277
QB009	Chiusaforte	Morainic deposits of the mountain sector and the morainic amphitheatre of the Tagliamento	Alpine, Special protection area containing a Site of Community interest	384225	5139144

An overview of the sites is available on the map.



Will be implemented the number of monitoring sites within the perimeter of the Alpine Convention.

11. Parameter groups

- Site characteristics (soil type etc.)

- Soil chemistry
    - pH-value
- Soil biodiversity
- Climate parameters
    - Soil temperature

12. Data availability

The data are restricted. Meta information is available. It is not in line with INSPIRE.

13. Monitoring mechanisms

Among the objectives of the agency ARPA FVG is included the monitoring of soil biodiversity through the application of the QBSar method devised by Vittorio parisi (and published in 2001) for the assessment of soil biological quality in relation to the level of soil adaptation of the micro arthropod community (ar). The monitoring phase of the 7 sites started between 2018 and 2019. A monitoring frequency is expected every two years. In summary, the method includes the following steps:
• Sampling;
• Measurement of pH and soil temperature, determination of texture and bulk density;
• Extraction of arthropods;
• Determination of biological forms (FB);
• Calculation of the QBSar Index.

The method is currently not governed. It is applied by different regions on a voluntary basis. ARPA FVG is part of the national reference working group for the applications and evolution of the Biological Soil Quality Index (QBS-ar). The method has been widely applied at national level and is also attracting increasing interest at international level.

13. Other available information

Website of ARPA FVG about soil's biodiversity is under working. The only document currently available is the following:
http://www.arpa.fvg.it/export/sites/default/tema/suolo/Allegati/poster-siss-modalit-compatibilit.pdf

QBS-ar methodology description:
https://www.sciencedirect.com/science/article/abs/pii/S1470160X17307422

Comments by the assessor:

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Soil Protection Working Group

Questionnaire permanent monitoring sites

FL – Soil Monitoring Network - Principality of Liechtenstein

National Name: Bodenmessnetz – Fürstentum Liechtenstein

1. Brief description of the instrument

The introduction of the Soil Monitoring Network is based on the environment protection law. The task of the soil monitoring network is to record the contamination of soil pollutants as well as soil fertility in general. Repeated sampling of the same sites is intended to identify the longer-term development of pollutant loads.
In the years 1994-96 topsoil samples were collected at 37 locations, which are distributed over the whole nation in a grid of 2 x 2 km. The sampled areas are currently used as forest, alpine pasture, grassland or arable land. Resampling took place at locations with critical loads of pollutants.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

The Office for Environment is responsible for the implementation and/or evaluation of the monitoring scheme (https://www.llv.li/inhalt/12298/amtsstellen/amt-fur-umwelt)

3. Type of instrument

The Soil Monitoring Network is a national monitoring system.

4. Status of policy instrument

The Soil Monitoring Network is in place since 1994.

5. Territorial coverage

The grid of the Soil Monitoring Network covers the whole nation.

6. Sectoral coverage

The Soil Monitoring Network covers the sectors agriculture and forestry.

7. Soil threats addressed by instrument

The Soil Monitoring Network addresses:

- contamination

8. Soil functions addressed by instrument

The Soil Monitoring Network addresses:

- no specific soil functions mentioned.

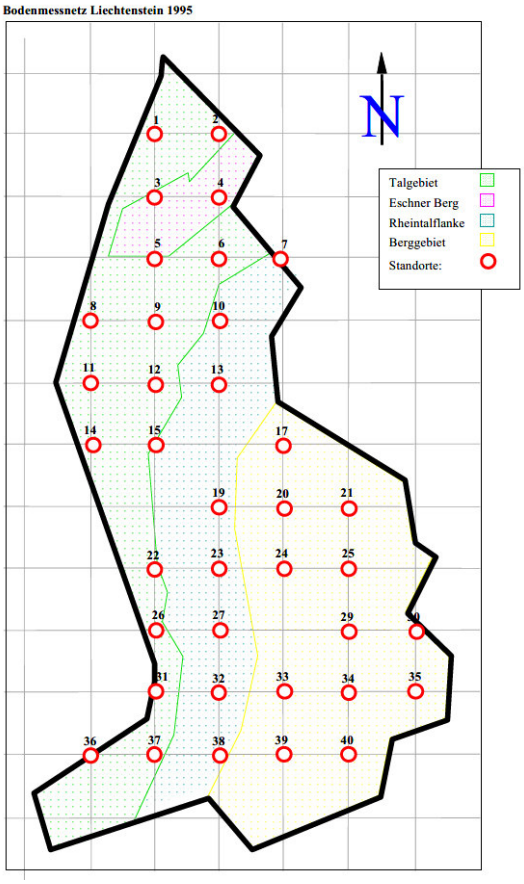
9. Land cover classes addressed by the instrument

The Soil Monitoring Network addresses:

- agricultural areas,
- forests,
- semi-natural areas,
- wetlands

10. Monitoring sites

All the monitoring sites are situated within the perimeter of the Alpine convention. They are distributed in a grid of 2 x 2 km and cover the whole nation. Therefore, the monitoring sites cover agricultural and forest areas in the lowlands, mountain area as well as in alpine regions.



11. Parameter groups

- Site characteristics (granulation)
- Soil chemistry
    - Heavy metal contamination (Cu, Ni, Cd, Zn, Pb, Hg, Co, F)
    - pH-Value
    - Soil salinity
- Soil carbon
- Phosphorous content
- Nitrogen content
- FeOxid (amorph)
- AlOxid (amorph)
- Cation exchange capacity (CEC)

12. Data availability

On request, data are freely available including meta-information. Currently, the available data is not in line with Inspire.

13. Monitoring mechanisms

After the initial sampling resampling took place just at locations with critical loads of heavy metals. The resampling was conducted to gain additional information about the source of contamination. According to the current state of knowledge, it is expected that no further systematic increase in heavy metal contamination is taking place. Thus, further sampling is planned in long term intervals.

There are indications that there are additional pollutants which should be integrated in the soil monitoring. Therefore, the office of environment is evaluating how to further develop the existing monitoring tool.

13. Other available information

There is no additional information available.

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Soil Protection Working Group

Questionnaire permanent monitoring sites

Please send your feedback ***by FR, 13.09.2019*** *to vera.bornemann@alpconv.org to allow us to prepare an overview of the results for the 2nd meeting of the working group.*
When filling out this document, please do not use footnotes. If you would like to make comments, use the Comments section at the end. Please delete this instruction text and the other instructions in the document. Just keep the answers. Please copy the questionnaire as many times as needed starting with a new page for every monitoring scheme, or use separate document for every monitoring scheme you will send in.

SI – Monitoring of Negative Impacts of Air Pollution on Ecosystems - NEC Directive

National Name: Monitoring negativnih vplivov onesnaženega zraka na ekosisteme (not yet an official name)

1. Brief description of the instrument

According to Article 9 of NEC Directive 2016/2884 monitoring of impacts of air pollution on ecosystems has to be ensured. The aim of Directive is to improve human health and the condition of ecosystems across the EU. The intention is to reinforce the ecosystem monitoring network needed to determine the state of, and predict changes in, terrestrial and freshwaters ecosystems in a long-term perspective with respect to the impacts of SO_X, NO_X, NH_3, and ground level ozone (acidification, eutrophication, ozone damage or changes on biodiversity). Thus, the objective of the monitoring is to improve information on the impacts of air pollution, including the extent of any impacts and the recovery time when the impacts are reduced, and to contribute to review of critical loads and levels. The air pollution impacts of interest for the ecosystem monitoring are: acidification, eutrophication and ozone damage. While the impacts of other pollutants (e.g. metals) are also of concern, a staged approach is suggested and it is proposed that the first phase of monitoring focus on these three issues.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

For the implementation and/or evaluation of the monitoring scheme are responsible Ministry of the Environment and Spatial Planning (https://www.gov.si/drzavni-

organi/ministrstva/ministrstvo-za-okolje-in-prostor/) and Slovenian Environment Agency (https://www.arso.gov.si/).

3. Type of instrument

- international monitoring systems,
- national monitoring systems,
- instrument with direct impact on soil.

4. Status of policy instrument

- in pipeline.

5. Territorial coverage

- national (MS level).

6. Sectoral coverage

Sectors:

- agriculture,
- forestry,
- cross sectoral.

7. Soil threats addressed by instrument

- contamination,
- loss of soil biodiversity.

8. Soil functions addressed by instrument

- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- agricultural areas,
- forests,
- semi-natural areas,
- wetlands,
- water bodies.

10. Monitoring sites

There are three monitoring sites in the perimeter of the Alpine Convention:

1. Spodnja Krma (also site in Research of Soil Pollution in Slovenia)

Monitoring site - Spodnja Krma is located in the Krma Valley, at an altitude of 835 m. Longitude and latitude of the site are 46,4080 and 13,9286, respectively. The land use is a grassland. The soil is shallow and very humorous, making it slippery when wet. There is a small chance of wind and water erosion. Potentially, soil can only be threatened by the occurrence of torrential deposits from the eastern slopes. The soil type is rendzina on a moraine. The soil has a well-developed and humus-rich A horizon. The soil pH is slightly alkaline. The cation exchange capacity is high due to the high content of organic matter. The cation exchange capacity is also affected by the presence of carbonates in the soil. The soil is unpolluted. Despite the small total soil depth, the transport of contaminants is expected to be slow due to the high content of organic matter, which acts as a mechanical, physicochemical and biological filter.

2. Pohorje-Tratice (also monitoring site in ICP Forests, see site characteristics in questionnaire permanent monitoring sites for ICP Forests)
3. Trnovski gozd – Fondek (also monitoring site in ICP Forests, see site characteristics in questionnaire permanent monitoring sites for ICP Forests)

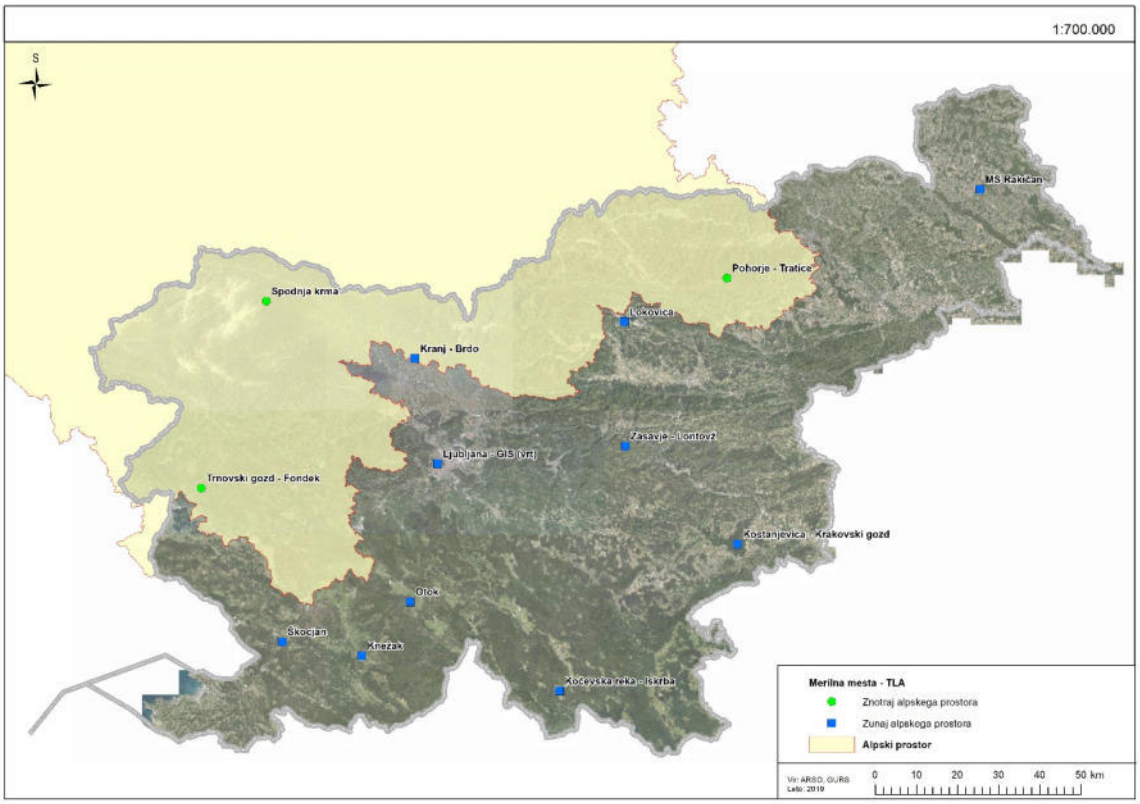

Figure 1: Spatial display of the monitoring sites in the framework of Monitoring of Negative Impacts of Air Pollution on Ecosystems - NEC Directive. The perimeter of the Alpine Convention is marked with yellow and green circle indicates that monitoring site is within this perimeter.

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
  - Organic compounds
- Soil carbon

12. Data availability

Data and meta-information are partly free available. Some data are in line with INSPIRE.

13. Monitoring mechanisms

The Monitoring of Negative Impacts of Air Pollution on Ecosystems according to Article 9 of NEC Directive 2016/2884 is based on other monitoring systems, survey and research. Thus, its monitoring sites and its soil data are selected from ICP Forest (**http://icp-forests.net/**) , LUCAS survey (**https://esdac.jrc.ec.europa.eu/projects/lucas**) and Research of Soil Pollution in Slovenia (**https://publications.europa.eu/en/publication-detail/-/publication/538dee5b-dfbf-45d6-bc3c-d4b6fab3110d/prodSystem-cellar/language-en/format-PDF pages 88-95**.). Therefore, some harmonisations within monitoring system is still needed.

Only relevant parameters are determent on certain monitoring site. Therefore, it is not necessary that all parameters included in monitoring system are determined at certain monitoring site. As an example, cropland is not relevant for nutrient load but is relevant for ozone damage.
Several parameters are included in the monitoring system, from which some are also related to terrestrial vegetation and freshwater ecosystem. Only soil related parameters are listed below:

- longitude and latitude to identify site location;
- ecosystem type (MAES classification), "Eunis class" Site Status (protected non-protected, unknown), Biogeographic region, elevation, slope, orientation/exposition to describe the site;
- date of profile description, soil type/soil group (WRB), soil qualifieres and specifiers (WRB), soil profile, soil horizon depths, WRB reference, parent material, effective soil depth, number of sampling layers and sampling depths, horizont number and horizont name in order to describe soil profile and soil characteristics;
- C_{tot}, C_{min} (carbonates), C_{org}, N_{tot}, C/N, pH ($CaCl_2$), CEC, Base Saturation, Ca, Mg, K, Na, Mn, P, Al_{tot}, conductivity, NH_4-N, NO_3-N, SO_4-S, DOC in order to determine soil acidity and eutrophication in soild or liquid phase.

Each parameter has its own sampling frequency (from 1 to 10 years).

The scheme helps to establish harmonised monitoring data at international and national level and encourages to coordinate it with other monitoring programmes established pursuant to Union legislation including Directive 2008/50/EC, Directive 2000/60/EC of the European Parliament and of the Council (1) and Council Directive 92/43/EEC (2) and, if appropriate, the LRTAP Convention.

13. Other available information

Ecosystem monitoring under Article 9 and Annex V of Directive 2016/2284(NECD) Draft Guidance - Version 2
https://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetailDoc&id=35724&no=3

Directive 2016/2284(NECD)
https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016L2284&from=EN

Comments by the assessor: /

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Soil Protection Working Group

Questionnaire permanent monitoring sites

SI–ICP Forests Level II

Intensive monitoring of forest ecosystems

1. Brief description of the instrument

The Level II intensive monitoring comprises around 500 plots all over Europe in selected forest ecosystems with the aim to clarify cause-effect relationships. At present 42 countries in Europe and beyond participate in ICP Forests.

Task Force is the highest body of ICP Forests, and it represents all participating countries. National experts are organized in Expert Panels and Working Groups, which ensure the continuous development and harmonization of the monitoring methods and contribute to data evaluations.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Slovenian Forestry Institute (Gozdarski inštitut Slovenije) http://www.gozdis.si/domov/

3. Type of instrument

- international monitoring systems,
- national monitoring systems,

4. Status of policy instrument

- In place (from 2003 on),

5. Territorial coverage

- international,
- national (MS level),

6. Sectoral coverage

Sectors:

- forestry,

7. Soil threats addressed by instrument

- loss of soil organic matter,
- contamination,

8. Soil functions addressed by instrument

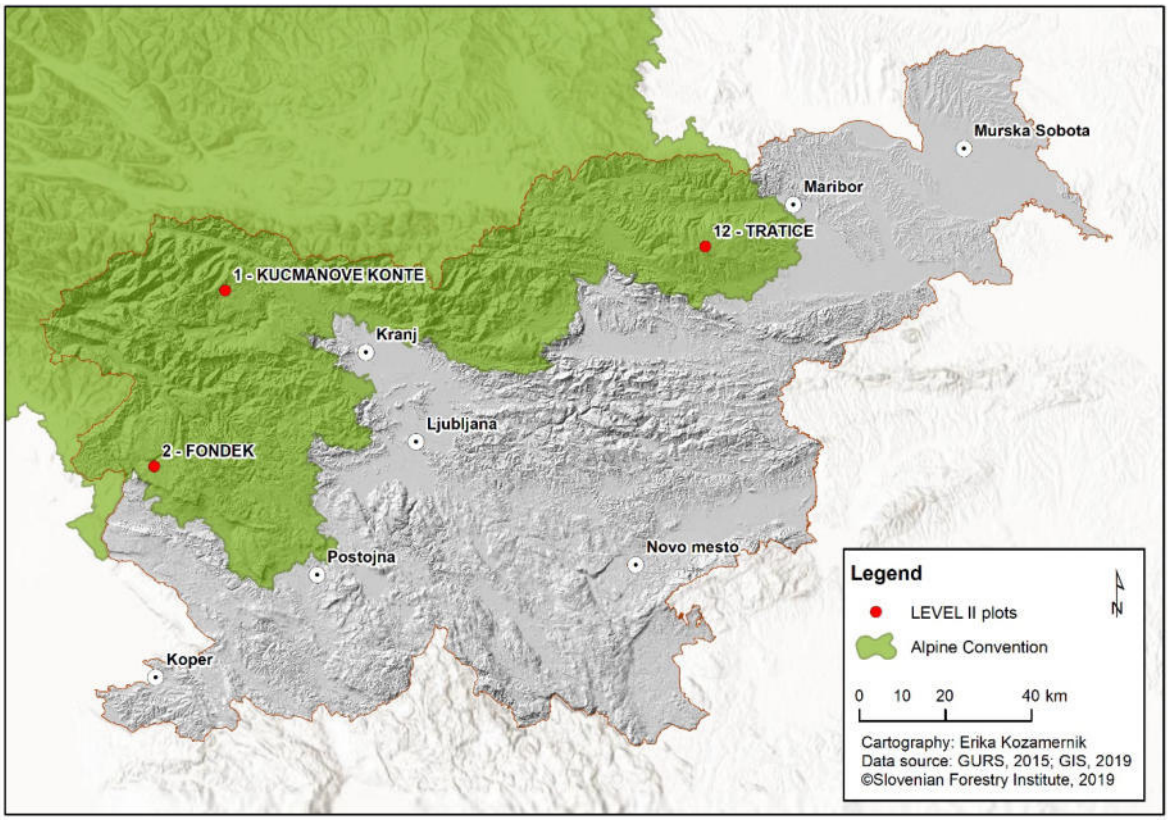
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- acting as carbon pool,
- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

- forests,

10. Monitoring sites

No. of the plot	Name	latitude	longitude	m a. s. l.	age	average height	date of establishement	main tree species	no. of tres	size of the plot (ha)
1	KRUCMANOVE KONTE	+462204	-+135636	1397	130	28	2.7.2003	*Picea abies*	227	0.25
2	FONDEK	+455955	+134416	827	80	17	1.7.2003	*Fagus sylvatica*	108	0.25
12	TRATICE	+462748	+152312	1289	80	26	7.9.2009	*Picea abies & Fagus sylvatica*	107	0.25



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
- Soil carbon
- Climate parameters

12. Data availability

Data are available via ICP Forests data base (according to ICP Forests data share policy). It is in line with INSPIRE.

13. Monitoring mechanisms

- The monitoring is under the Convention on Long-Range Transboundary Air Pollution (CLRTAP), Working Group on Effects (WGE), Integrated co-operation Programme on Forests (ICP Forests) methodology. Level II (Intensive monitoring) includes: soil survey, soil solution, forest stands (crown condition, damage, growth, yield, nutrient stock), ground vegetation, meteorological data, deposition in the open field and in the forest, ozone injuries and ozone concentration. Each survey has its own sampling frequency. It goes from 14 days (deposition, ozone concentration) to soil

survey (10 years or more).

- The methodology of the soil sampling design, soil sampling performance, soil analysis, data providing, data reporting and soil samples storage are full harmonized at international level.

13. Other available information

http://icp-forests.net/
http://icp-forests.net/page/level-ii
http://icp-forests.net/page/icp-forests-manual
http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/15905/1/lbna24729enc.pdf

Comments by the assessor:

In the frame of ICP Forests programme exists the intention to expand the set of soil sampling parameters: e. g. soil biodiversity, plant available phosphorous etc.

SI-ICP Forests Level I

16 × 16 km grid

1. Brief description of the instrument

The Level I monitoring is based on around 6000 observation plots on a systematic transnational grid of 16 x 16 km throughout Europe and beyond to gain insight into the geographic and temporal variations in forest condition. At present 42 countries in Europe and beyond participate in ICP Forests.

Task Force is the highest body of ICP Forests, and it represents all participating countries. National experts are organized in Expert Panels and Working Groups, which ensure the continuous development and harmonization of the monitoring methods and contribute to data evaluations.

The first survey was conducted in 1995/1996 aiming at monitoring traditional pedology parameters, as well as heavy metals. The repetition was made in 2006 in the frame of the BioSoil project.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Slovenian Forestry Institute (Gozdarski inštitut Slovenije) http://www.gozdis.si/domov/

3. Type of instrument

- international monitoring systems,
- national monitoring systems,

4. Status of policy instrument

- In place (),

5. Territorial coverage

- international,
- national (MS level),

6. Sectoral coverage

Sectors:

- forestry,

7. Soil threats addressed by instrument

- loss of soil organic matter,
- contamination,
- No specific soil threats are mentioned.

8. Soil functions addressed by instrument

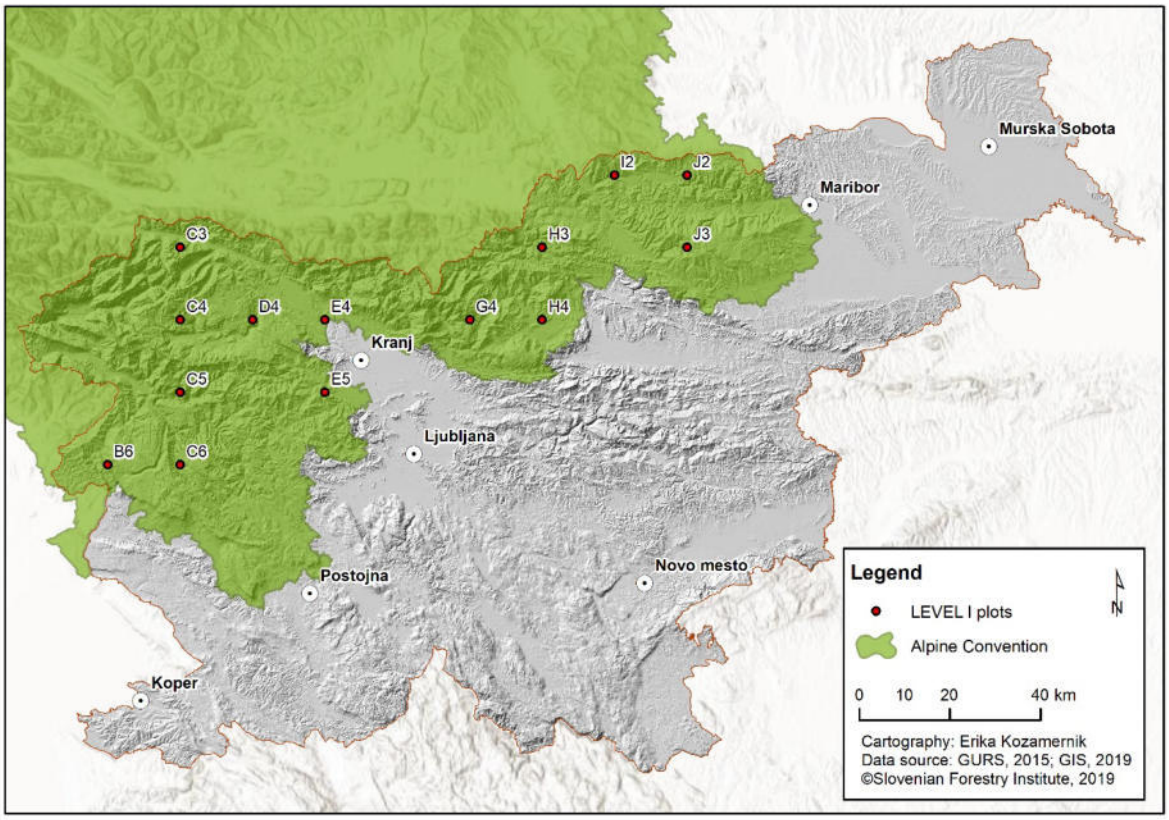
- storing, filtering, transforming nutrients or water,
- acting as carbon pool,

9. Land cover classes addressed by the instrument

- forests,

10. Monitoring sites

Plot code	Latitutde	Longitude	m a. s. l.
G4	+474950	+131000	1150
H4	+490950	+131000	430
D4	+426950	+131000	1020
C4	+410950	+131000	1460
E4	+442950	+131000	510
H3	+490950	+147000	870
I2	+506950	+163000	650
J2	+522950	+163000	535
C6	+410950	+99000	465
C3	+410950	+147000	1150
E5	+442950	+115000	550
C5	+410950	+115000	670
B6	+394950	+99000	505
J3	+522950	+147000	1300



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
  - Heavy metal concentrations
- Soil carbon

12. Data availability

Data are available via ICP Forests data base (according to ICP Forests data share policy). It is in line with INSPIRE.

13. Monitoring mechanisms

- The monitoring is under the Convention on Long-Range Transboundary Air Pollution (CLRTAP), Working Group on Effects (WGE), Integrated co-operation Programme on Forests (ICP Forests) methodology. Level I include: soil survey, forest stands (crown condition, damage). Each survey has its own sampling frequency. It goes from yearly (forest stands conditions) to soil survey (10 years or more; two soil surveys were made in 1995 and 2006).

- The methodology of the soil sampling design, soil sampling performance, soil analysis, data providing, data reporting and soil samples storage are full

harmonized at international level.

13. Other available information

http://icp-forests.net/
http://icp-forests.net/page/largescale-forest-condition
http://icp-forests.net/page/icp-forests-manual
http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/15905/1/lbna24729enc.pdf

Comments by the assessor:

Soil Protection Working Group

Questionnaire permanent monitoring sites

SI-8 × 8 km grid (Public Environment Service – Ministry of the Environment and Spatial Planning)

1. Brief description of the instrument

The main task of the instrument, on demand of the Ministry of the Environment and Spatial Planning, is carrying out activities related to greenhouse gas sink assessments for the field “Land use, land use change and forestry” (LULUCF) in accordance with the Rules on monitoring sinks and greenhouse gas emissions from land use, land use change and forestry.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Slovenian Forestry Institute (Gozdarski inštitut Slovenije) http://www.gozdis.si/domov/

3. Type of instrument

- national monitoring systems,

4. Status of policy instrument

- In place (since 2010),

5. Territorial coverage

- national (MS level),

6. Sectoral coverage

Sectors:

- forestry,

7. Soil threats addressed by instrument

- loss of soil organic matter,
- No specific soil threats are mentioned.

8. Soil functions addressed by instrument

- storing, filtering, transforming nutrients or water,
- acting as carbon pool,

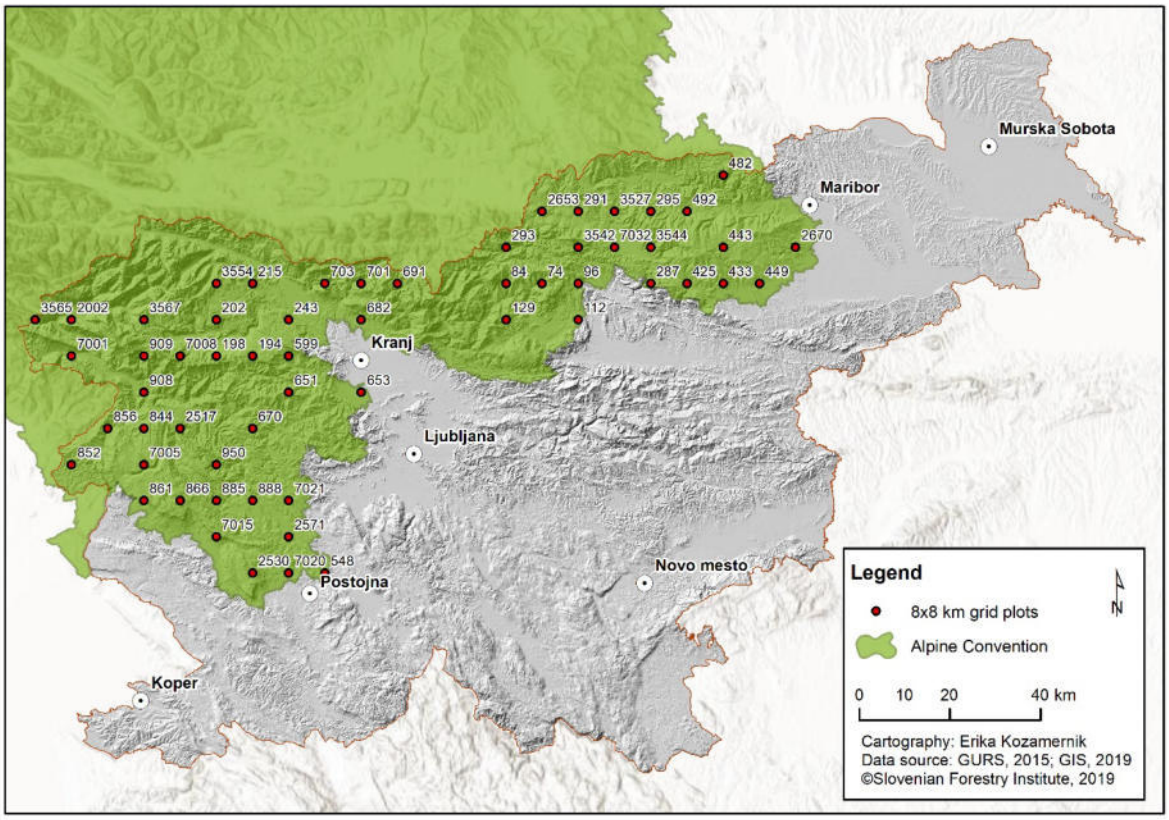
9. Land cover classes addressed by the instrument

- forests,

10. Monitoring sites

Plot code	Latitude	Longitude	m a. s. l.
KPP 74	+490950	+139000	1010
KPP 84	+482950	+139000	870
KPP 96	+498950	+139000	450
KPP 112	+498950	+131000	580
KPP 129	+482950	+131000	780
KPP 194	+426950	+123000	1480
KPP 198	+418950	+123000	1275
KPP 202	+418950	+131000	1375
KPP 215	+426950	+139000	810
KPP 243	+434950	+131000	890
KPP 287	+514950	+139000	810
KPP 291	+498950	+155000	430
KPP 293	+482950	+147000	1260
KPP 295	+514950	+155000	750
KPP 425	+522950	+139000	505
KPP 433	+530950	+139000	620
KPP 443	+530950	+147000	1300
KPP 449	+538950	+139000	400
KPP 482	+530950	+163000	675
KPP 492	+522950	+155000	555
KPP 548	+442950	+75000	590
KPP 599	+434950	+123000	740
KPP 651	+434950	+115000	1085
KPP 653	+450950	+115000	360
KPP 670	+426950	+107000	810
KPP 682	+450950	+131000	580
KPP 691	+458950	+139000	1105
KPP 701	+450950	+139000	1090
KPP 703	+442950	+139000	1030

KPP 844	+402950	+107000	765
KPP 852	+386950	+99000	240
KPP 856	+394950	+107000	320
KPP 861	+402950	+91000	700
KPP 866	+410950	+91000	1095
KPP 885	+418950	+91000	670
KPP 888	+426950	+91000	660
KPP 908	+402950	+115000	230
KPP 909	+402950	+123000	550
KPP 950	+418950	+99000	445
KPP 2002	+386950	+131000	570
KPP 2517	+410950	+107000	430
KPP 2530	+426950	+75000	1070
KPP 2571	+434950	+83000	600
KPP 2653	+490950	+155000	630
KPP 2670	+546950	+147000	450
KPP 3527	+506950	+155000	575
KPP 3542	+498950	+147000	874
KPP 3544	+514950	+147000	876
KPP 3554	+418950	+139000	1846
KPP 3565	+378950	+131000	1000
KPP 3567	+402950	+131000	1750
KPP 7001	+386950	+123000	252
KPP 7008	+410950	+123000	1719
KPP 7015	+418950	+83000	575
KPP 7020	+434950	+75000	538
KPP 7021	+434950	+91000	597
KPP 7032	+506950	+147000	500
KPP 7005	+402950	+99000	790



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
  - pH-value
- Soil carbon

12. Data availability

Are data free available or restricted? Is meta-information available? Is it in line with INSPIRE?

Data are incorporated in the NIR report under the UNFCCC and are available upon request.

13. Monitoring mechanisms

- The soil survey and monitoring mechanism is introduced for the purpose of LULUCF.

- The methodology of the soil sampling design was established for national use only. Soil sampling performance, soil analysis and soil samples storage are performed in harmonized way at international level. Data are processed and prepared for LULUCF reporting.

13. Other available information

https://unfccc.int/topics/land-use/workstreams/land-use--land-use-change-and-forestry-lulucf
https://www.gov.si/en/state-authorities/ministries/ministry-of-the-environment-and-spatial-planning/about-us/
http://icp-forests.net/page/icp-forests-manual

Comments by the assessor:

alpenkonvention • convention alpine
convenzione delle alpi • alpska konvencija

Soil Protection Working Group

Questionnaire permanent monitoring sites

CH – Swiss Soil Monitoring Network (NABO)

Nationale Bodenbeobachtung (NABO)

1. Brief description of the instrument

The National Soil Monitoring Network (NABO) records and documents the temporal development of the quality of Swiss soils based on chemical, physical and biological soil properties. Their tasks also include early detection and forecasting of changes. To do so, they operate a long-term monitoring system that monitors soils under their normal management. For this purpose, they regularly sample a monitoring network of around 110 sites spread across Switzerland. They also collect annually management and land use data at selected sites. In addition to the long-term monitoring, NABO conducts supplementary studies on current issues.

As a service, NABO offers consultation services for a diverse clientele with various needs. These services include developing recommendations for cantonal authorities, addressing specific soil-related questions of federal offices and offering technical advice to private clients. In addition, NABO regularly performs proficiency testing. These evaluations are commissioned by the federal government and conducted for interested laboratories to ensure data quality.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

NABO (https://www.agroscope.admin.ch/agroscope/en/home/topics/environment-resources/soil-bodies-water-nutrients/nabo.html)

3. Type of instrument

- national monitoring systems,

4. Status of policy instrument

- In place (since 1985),

5. Territorial coverage

- national (MS level),
- regional (federal state or non-federal state),

6. Sectoral coverage

Here we want to identify the sectors that the monitoring scheme covers. There may be monitoring schemes which cover a range of sectors or are on purpose cross-sectoral. However, some may target only one or two sectors. The sectoral coverage gives us an indication also of what types of drivers behind soil degradation the instrument is likely to address. The section on territorial and sectoral coverage will also help to discern whether the spatial and sectoral coverage of the instrument is limited compared to its potential. DELETE answers which are not relevant and the instructions text:

Sectors:

- cross sectoral.

7. Soil threats addressed by instrument

- No specific soil threats are mentioned.

8. Soil functions addressed by instrument

- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

Here we identify what types of land covers are affected by the instrument. These are Corine land cover classes. The land uses in the monitoring might not correspond directly to these broad classes. DELETE not relevant ones.

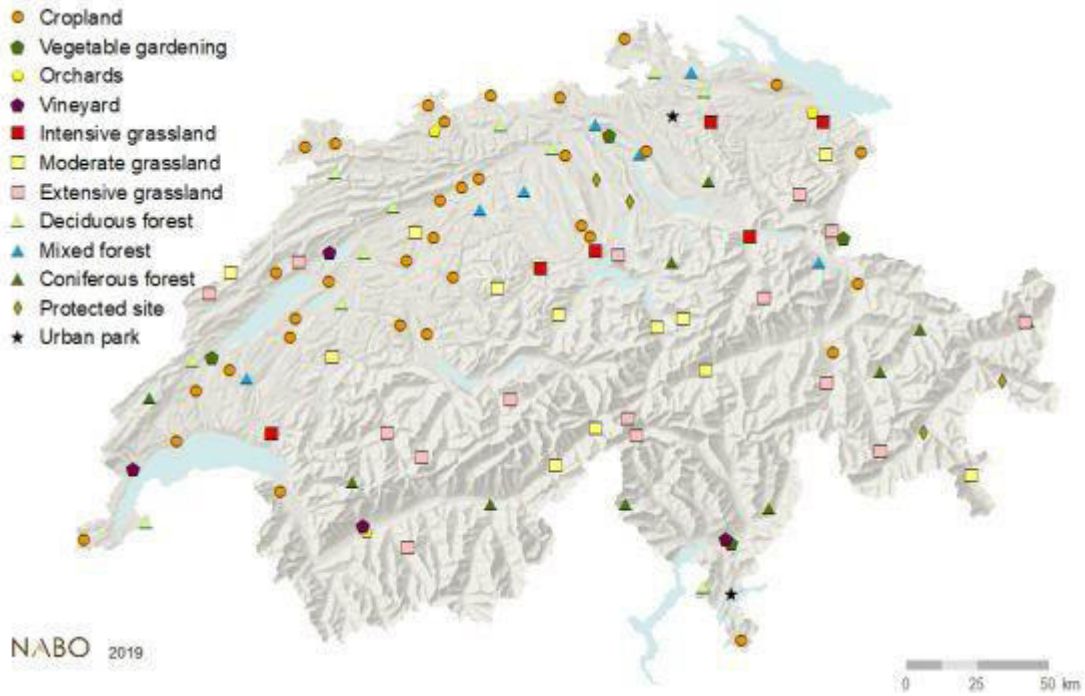
- no specific land cover classes are mentioned/inferred.

10. Monitoring sites

Please list here the monitoring sites, which are in the perimeter of the Alpine Convention. List the locations, site characteristics and other relevant information as exact as possible in writing. Please include cartographic overview(s), if available.

The Swiss Soil Monitoring Network NABO assesses and documents the soil quality at 111 monitoring sites. The selected NABO sites represent a combination of land

use, soil type, geology, altitude and other site properties that are typical of Switzerland. Approximately two thirds are agricultural sites (arable land, permanent grassland, special crops) and one third are located in forests.



11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Organic compounds
- Soil carbon
- Soil biodiversity
- Climate parameters
    - Soil temperature

12. Data availability

Access to the data is restricted, but interested parties can ask for information from the NABODAT information system. The access to all the publications is free.

13. Monitoring mechanisms

At the monitoring site, chemical, physical and biological investigations are conducted. Soil samples are collected at least every 5 years. Consequently, consistent time series over more than 30 years are available.

NABO carries out an additional indirect monitoring. Data on agricultural use will be collected for selected sites and material balances derived. Substance balancing helps to identify undesirable developments in the soil at an early stage and enables forecasts and scenarios to be drawn up. This modelling instrument serves as a precautionary tool in soil protection.

13. Other available information

NABO (https://www.agroscope.admin.ch/agroscope/en/home/topics/environment-resources/soil-bodies-water-nutrients/nabo.html)

Publications (https://www.agroscope.admin.ch/agroscope/en/home/topics/environment-resources/soil-bodies-water-nutrients/nabo/publications.html)

NABODAT Information System (https://www.nabodat.ch/index.php/de/)

Comments by the assessor:

TEMPLATE:

Country Prefix – Name of the monitoring scheme

Please replace the heading ‘country prefix – name of the monitoring scheme’ with the standard country prefix (e.g. DE, AT) and include the English name of the monitoring scheme.

National Name: Include here the name in the respective national language, and delete this instruction text.

1. Brief description of the instrument

Briefly summarize the main content of the monitoring scheme (its aim and scope, links to policy objectives and other policy instruments, which parameters it focuses on, other key information you think is relevant to understand the monitoring scheme)

Please KEEP to around 150 words.

2. Institution(s) responsible for the implementation and/or evaluation of the policy instrument

Which institutions are responsible for the implementation and/or evaluation of the monitoring scheme? Please include the names and link to their home pages, and delete the instructions text.

3. Type of instrument

Please choose the type of monitoring scheme, DELETE those which do not apply.

- international monitoring systems,
- national monitoring systems,
- regional monitoring systems,
- instrument with direct impact on soil.

4. Status of policy instrument

DELETE the answers which do not apply.

- In place (indicate how long),
- in pipeline,
- proposed.

5. Territorial coverage

DELETE not relevant answers.

- international,
- national (MS level),
- regional (federal state or non-federal state),
- sub-regional.

6. Sectoral coverage

Here we want to identify the sectors that the monitoring scheme covers. There may be monitoring schemes which cover a range of sectors or are on purpose cross-sectoral. However, some may target only one or two sectors. The sectoral coverage gives us an indication also of what types of drivers behind soil degradation the instrument is likely to address. The section on territorial and sectoral coverage will also help to discern whether the spatial and sectoral coverage of the instrument is limited compared to its potential. DELETE answers which are not relevant and the instructions text:

Sectors:

- agriculture,
- forestry,
- infrastructure,
- cross sectoral.

7. Soil threats addressed by instrument

The European Soil Thematic Strategy identifies 8 soil threats. These include: erosion, flooding and landslides, loss of soil organic matter, salinization, contamination, compaction, soil sealing and loss of soil biodiversity. Please keep the answers as they are – i.e. don't add or rewrite the answers.

Which threats are addressed **explicitly**, i.e. the monitoring scheme explicitly aims to address the threat (this is stated in its scope, objectives, or the activities and mechanisms it includes)? DELETE answers that are not relevant.

- erosion,
- flooding landslides,
- loss of soil organic matter,
- salinization,
- contamination,
- compaction,
- soil sealing,
- loss of soil biodiversity,
- No specific soil threats are mentioned.

8. Soil functions addressed by instrument

Which soil functions does the monitoring scheme address – i.e. provide support for, either explicitly or implicitly. (Explicitly means that addressing the soil function is

stated in its scope, objectives, or the activities and mechanisms it includes; implicitly means that the instrument may have implications for the soil function, but this is not explicitly stated in the text). DELETE answers that are not relevant.

- biomass production,
- storing, filtering, transforming nutrients or water,
- hosting biodiversity pool,
- platform for human activity,
- providing raw materials,
- acting as carbon pool,
- storing geological and archeological heritage,
- no specific soil functions mentioned.

9. Land cover classes addressed by the instrument

Here we identify what types of land covers are affected by the instrument. These are Corine land cover classes. The land uses in the monitoring might not correspond directly to these broad classes. DELETE not relevant ones.

- artificial surfaces,
- agricultural areas,
- forests,
- semi-natural areas,
- wetlands,
- water bodies,
- no specific land cover classes are mentioned/inferred.

10. Monitoring sites

Please list here the monitoring sites, which are in the perimeter of the Alpine Convention. List the locations, site characteristics and other relevant information as exact as possible in writing. Please include cartographic overview(s), if available.

11. Parameter groups

- Site characteristics (soil type etc.)
- Soil chemistry
    - pH-value
    - Heavy metal concentrations
    - Organic compounds
- Soil carbon
- Soil biodiversity
- Soil erosion
- Climate parameters
    - Soil temperature

12. Data availability

Are data free available or restricted? Is meta-information available? Is it in line with INSPIRE?

13. Monitoring mechanisms

This section is included to provide information on monitoring mechanisms associated with different types of policy instruments (e.g. Alpine Convention, environmental or soil protection acts, or water legislation, etc). Since you are filling out information for monitoring schemes as such, you can provide here more detail on the monitoring scheme itself (going beyond the text that you provided above in section 1 'brief description of the instrument'). I.e.:

- What types of monitoring is included; what parameters (broad categories are sufficient) are measured and for what purpose, with what frequency?
- Any other aspects of the monitoring scheme that you think are very important to understand its relevance for soil protection, for example, if the scheme helps to establish harmonised monitoring data at international or national level, or on the other hand if it is a private initiative, what its limitations might be, or if it could be expanded to cover a wider area.

13. Other available information

Provide link(s) to publications and to the websites which describe the monitoring mechanism.
Other links to information that is relevant and useful to illustrate the monitoring scheme and its implementation. This could include, for example, guidance documents.

Comments by the assessor:

Here you can provide any additional comments that you might have, for example:

- If you didn't think that the closed-ended questions (those with a list of answers) included the appropriate answer for the monitoring scheme in question
- If you would like to point out a specific characteristic of the instrument that is not included in the above headings.
- If you were uncertain about a particular answer, and you would like to add a comment about it
- If, for example, the instrument is very important for a particular soil threat / function even though it only deals with it implicitly, you can also comment here.
- Any other comment that you would like to make about availability of information, the nature of the instrument or anything else to communicate to the study team