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Green Paper

The urgent necessity of healthy soils

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and Martin Doeswijk

Introduction

In 2021 the authors (Margot de Cleen and Martin Doeswijk) of this Green Paper worked together intensively as members of the organising committee of the AquaConSoil conference. AquaConSoil is an international conference focusing on the topics of the sustainable use and management of soil, sediment and water resources; the last edition was held in June 2021. The authors presented the interactive closing session. During their preparation for this session and throughout it, Margot and Martin frequently discussed their passion for soil, more precisely: healthy soil and the importance of it. This passion was encouraged by the enthusiastic contributions and technical capabilities of the different stakeholders involved in this field, including: policy makers, academics, environmental consultants, engineers and contractors. During their preparation, more philosophic (Give Soil A Voice) and holistic themes also arose: The soil is literally and figuratively the foundation of our very existence - yet we do not treat it as we should). An idea was put forth to gather input at the conference for a 10-point action plan in the broader context of the importance of healthy soil, as outlined in the EU mission 'A Soil Deal for Europe'. The holistic view we are aiming for is embodied by the EU statement that "Life on earth depends on healthy soils. Soil is the foundation of our food systems. It provides clean water and habitats for biodiversity while contributing to climate resilience. It supports our cultural heritage and landscapes and is the basis of our economy and prosperity".¹ Then, at the end of 2021, the EU Soil Strategy for 2030 'Reaping the benefits of healthy soils for people, food, nature and climate' was published. We are convinced that the knowledge and actions coming out of the AquaConSoil Conference in 2021 can provide an incentive to further improve upon in the upcoming conference in Prague, in 2023 and can contribute to achieving the goals set in this Strategy. With this Green Paper we are aiming to present the larger context of the urgent necessity for healthy soils. We will make a connection with the EU Soil Strategy and Mission. This green paper is not a set proposal, but a starting point for debate and discussion and you are warmly invited to participate.

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1. EU Mission: A Soil Deal for Europe | European Commission (europa.eu)

1. Our joint mission

Everybody should be able to live in a healthy environment. Not only us, but also future generations. The soil – sediment – water system is the basis of a healthy environment. Therefore, we need to restore it, protect it and manage it sustainably. As a soil policy maker and consultant, we want to use our networks, knowledge and experience to bring together people, perspectives, practices and actions to achieve the goals set forth by the United Nations (UN) in the Sustainable Development Goals² as well as the goals and ambitions put forward in the European Soil Strategy.



2. THE 17 GOALS | Sustainable Development (un.org)

2. The WHY. This is the importance of healthy soils

2.1 Soils are our basis

Our environment defines who we are. Without healthy soils there is no food, no drinking water, no recreation, no healthy living, no wellbeing and no future. Because most people in the world are city dwellers, we are estranged from our soils. Few know about the services that soils provide them with, as soils are often invisible and covered by buildings, squares, roads and parking lots. Degradation of soil and land is severe and progressing. Although the soil is literally and figuratively the foundation of our very existence - we do not treat it as we should. Unawareness, next to short-term economic interests, overrule long-term societal and natural values. We neglect soil when taking measures and making decisions. Therefore, we need to 'see' the importance of soils and give soils a voice.

Over the past few years the urgency for healthy soils has become clearer and more visible, also to the larger public, as a result of rapid climate change, geopolitics and the planetary boundaries (shortage of resources, such as water and food and loss of biodiversity, desertification and pollution). The fact that environmental policy requirements and legislative goals on climate, water quality and nitrogen are not being met has led to restrictions in other sectors such as: building or speed restrictions.



It is estimated that between 60 and 70% of EU soils are unhealthy. Soil is a fragile resource that needs to be carefully managed and safeguarded for future generations. One centimeter of soil can take hundreds of years to form but can be lost in just a single rainstorm or industrial incident³.

3. European Commission, Directorate-General for Research and Innovation, Veerman, C., Pinto Correia, T., Bastioli, C., et al., *Caring for soil is caring for life : ensure 75% of soils are healthy by 2030 for healthy food, people, nature and climate : interim report of the mission board for soil health and food*, Publications Office, 2020, <https://data.europa.eu/doi/10.2777/918775> and the implementation plan: https://research-and-innovation.ec.europa.eu/system/files/2021-09/soil_mission_implementation_plan_final_for_publication.pdf

2.2 Fight Inequality

Procrastination, while a very human trait, undermines tackling major societal problems, such as the misuse of soils. The consequence of our lifestyle is that we deplete it, with the result that three quarters of our soils are unhealthy. Although we are aware of this, we are not sure how to solve the problem. Or we think others should just do it.

It is time to act thus that future generations inherit clean, productive and resilient soils.

In 1987, Our Common Future⁴ defined sustainability as “meeting the needs of the present without compromising the ability of future generations to meet their own needs.” More than one generation later we are still far from this goal. Unfortunately, we have to admit that we still face major differences in how countries and people use the natural system and resources. As Earth Overshoot Day⁵ shows, European countries consume more than twice the resources the Earth is able to regenerate in one year.

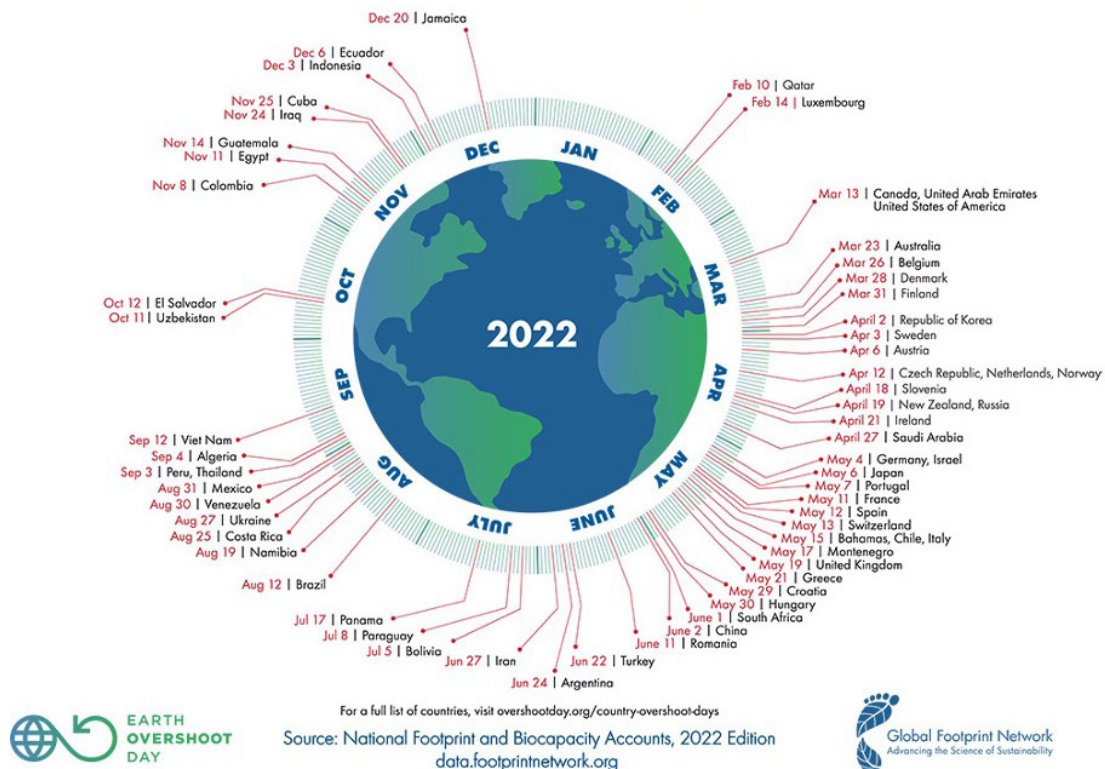


Figure 1 - Country Overshoot Days 2022, When would Earth Overshoot Day land if the world's population lived like...

4. Report of the World Commission on Environment and Development: Our Common Future

5. <https://www.overshootday.org/newsroom/country-overshoot-days/>

Today, there are almost 140 developing countries in the world seeking ways of meeting their development needs. With the increasing threat of climate change, concrete efforts must be made to ensure development today does not negatively affect future generations or other regions or countries⁶. Additionally, the continual passing on of environmental costs to other regions and generations should be prevented. In 2015 the United Nations set ambitions to assure a sustainable world for all in 2030, the Sustainable Development Goals (SDGs)⁷. These goals, a set of economic, social and planet goals are mutually interdependent and aim for a balance. Because the time and geographical scales of the economic, societal and planetary spheres do not align, it remains a challenge to connect the goals, align actions, create a balance and stop passing on social and environmental costs. Most of the economic, social and planet goals can only be achieved if the basis is healthy, and that basis is a healthy soil–sediment–water system.

We think the solution can be found in a global vision which functions as an “umbrella” for top down/bottom up approaches and initiatives at different levels and scales, from global to regional to local and vice versa. Global policies, global trade and consumption patterns, have a major impact on the soil - sediment - water system. Apart from multilateral treaties, multinational companies play a decisive role. They are in a position to initiate meaningful change, for example, by creating an environment for fair, healthy and planet-proof trade.

This is not enough, however. Initiatives on a local scale increase awareness and benefit the local community as a whole. Here, change can be realized and impact can be created due to the enormous potential. Results are more tangible and more quickly achieved. These initiatives act like a lighthouse, inspiring others beyond the physical limits of the project⁸. To be truly successful, promising local initiatives, need to be scaled up from local to regional to global. Authorities and multinationals can initiate this, supported by multilateral treaties. With these improvements, the global vision (the umbrella) can be modified, setting in motion a cascade of positive change.



We think the solution can be found in a global approach based on local initiatives. Because activities take place on a local scale, here change can be realized and impact can be created.

6. Sustainability | United Nations

7. <https://www.undp.org/sustainable-development-goals>

8. The term lighthouse project refers to a model project that aims, besides its original purpose, to have a signal effect for numerous follow-up projects as they look towards it for inspiration and guidance. Therefore, in addition to success, a great notoriety is intended.

2.3 Healthy soils for healthy societies

The EU Mission 'A Soil Deal for Europe'⁹ and the accompanying report of the mission board 'Caring for soil is caring for life'¹⁰ clearly underscores the significant role of soils for nature and society. Soil degradation worldwide threatens our health, wellbeing and prosperity, for us and for future generations. Increasingly fewer people have access to soil ecosystem services and the available services are not equally divided. This downward spiral leads to further biodiversity loss, severe soil and land degradation and adds to food and water insecurity, climate change and induces migration - a real doomsday scenario.

At the same time, the soil's ecosystem services often remain underused while they might sustain the challenges society has to overcome. Soil is essential in securing food and drinking water, but also in addressing climate change, sustaining biodiversity, stemming migration and creating liveable cities as well as in the transition towards sustainable energy. In addition to that, soil is part of and therefore indispensable for the earth ecosystem as a whole.

2.4 Give soils a voice

As soils are essential for welfare and well-being why are they hardly considered in decision making? The tragedy of the commons, the long reaction rate in the soil system slowing the impact of soil degradation, the invisibility of soil, the negative connotation of soil as dirt, the ever overpowering, short-term desire for economic benefits, the lack of community to oversee long term profit, the private ownership of land and the unawareness of soil and its services are all factors leading to poor soil decisions¹¹. The result is contaminated and degraded soil and land as well as damage to welfare, well-being and the global earth system. Soils should have a say in decision making and management. Should they have rights like human rights or are there other possible alternatives?¹²

9. https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe/soil-health-and-food_en

10. European Commission - Research and Innovation (2020). Caring for soil is caring for life.

11. Visser, Saskia, et al. (2019) *Soil as a Basis to Create Enabling Conditions for Transitions Towards Sustainable Land Management as a Key to Achieve the SDGs by 2030*. Sustainability 2019, 11, 6792.

12. Kwaadsteniet, R. (2020). *Geef de bodem een stem*. Een verkennende rapportage naar: Hoe geven we een stem aan de bodem? (W)aardewoord.

3. The WHAT. This is what we need

3.1 Ambitions to change

To achieve healthy soils, we need ambitions and goals, but that, alone, is insufficient. We need to cooperate more effectively and take action to change our current practices and break the downward spiral through restoration, protection and sustainable management of our soils. Platforms such as the AquaConSoil community (universities, knowledge institutes and consultancies, policy makers and land users), Common Forum on Contaminated Land (policy makers) and the Network for Industrially Co-ordinated Sustainable Land Management in Europe (NICOLE: industry, consultancies and universities and knowledge institutes) have the experience, knowledge and network to contribute to these goals and create positive impact. Based on the UN SDGs, the Green Deal for Europe, the Biodiversity Directive, the Mission 'A Soil Deal for Europe', the European Commission presented the EU Soil Strategy 2030¹³. To concretise the EU ambitions for soil eight Mission objectives are formulated¹⁴:

- reduce desertification,
- conserve soil organic carbon stocks,
- stop soil sealing and increase re-use of urban soils,
- reduce soil pollution and enhance restoration,
- prevent erosion,
- improve soil structure to enhance soil biodiversity,
- reduce the EU global footprint on soils,
- improve soil literacy in society.

This strategy sets the goal that 'all EU soil ecosystems are in a healthy condition' and are, thus, more resilient by 2050. By then, protection, sustainable use and restoration of soil will have become the norm.

13. European Commission, Directorate-General for Environment; EU Soil Strategy for 2030 Reaping the benefits of healthy soils for people, food, nature and climate; Brussels 17 November 2021. https://ec.europa.eu/environment/publications/eu-soil-strategy-2030_en

14. European Missions: A Soil Deal for Europe, table 1, pp. 16-17. https://research-and-innovation.ec.europa.eu/system/files/2021-09/soil_mission_implementation_plan_final_for_publication.pdf

The EU Soil Strategy definition: Soils are healthy when they are in good chemical, biological and physical condition, and thus able to continuously provide as many of the following ecosystem services as possible:

- **Provide food and biomass production, including in agriculture and forestry**
- **Absorb, store and filter water and transform nutrients and substances, thus protecting groundwater bodies**
- **Provide the basis for life and biodiversity, including habitats, species and genes**
- **Act as a carbon reservoir**
- **Provide a physical platform and cultural services for humans and their activities**
- **Act as a source of raw materials**
- **Constitute an archive of geological, geomorphological and archaeological heritage**

The message of the Soil Strategy and the Soil Mission are unambiguous and, in our opinion, contain concrete goals. It is an excellent basis to roll up our sleeves and make it work in all forms of land use!

3.2 Challenges to address

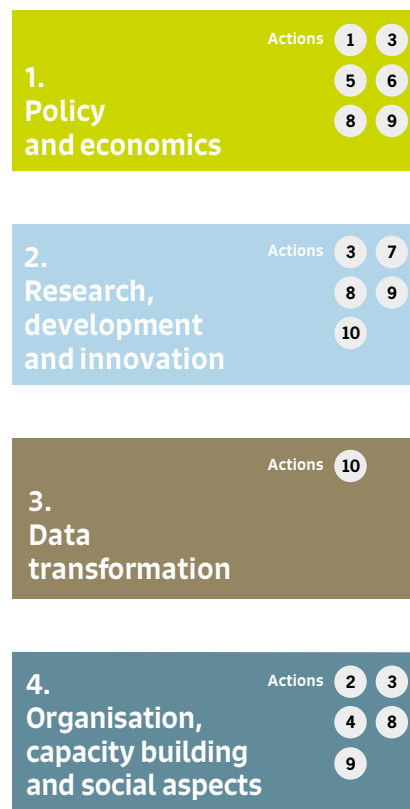
Taking into account the need for healthy soils, the desire to fight inequality among people, regions and generations¹⁵ by the global community and the European Commission, set objectives. The AquaConSoil community identified the following challenges to which it can contribute and make a positive impact in order to foster healthy soils and fight inequality (see figure 2):

15. Sustainable Development Goal 10 (SDG 10) is about reduced inequality and is one of the 17 SDG's established by the United Nations in 2015. The full title is: 'Reduce inequality within and among countries'

Challenges

- Restore/strengthen the balance between urban and rural areas
- Identify the best ways to move from global assessments to local action
- Involve the land user when addressing the quality of the soil-sediment-water system
- Sustainably use and protect soil-sediment-water systems
- Place healthy soil on the agenda and broaden the scope from soil contamination solely to soil function restoration for societal challenges
- Give soils a voice to underpin the objectives of the EU Green Deal
- Mark the approach of known and future emerging contaminants by the knowledge and experiences achieved in dealing with PFAS

Four Pillars of Action



10-point action plan

- 1 Give soils a voice in decision making and actions
- 2 Acknowledge the intrinsic value of soils
- 3 Transition in mindset and actions is crucial
- 4 Take responsibility, take control
- 5 Set land degradation to zero
- 6 Programmatic approach soil remediation
- 7 Connect soil with other societal challenges
- 8 New business models
- 9 New research and innovation models
- 10 Data, data and more data

Figure 2 - Challenges to which the European Commission can contribute to and make a positive impact in order to foster healthy soils and fight inequality

These challenges are further elaborated in 'the HOW' chapter.

The EU Soil Strategy and Soil Mission are not only inspiring and ambitious but also realistic and necessary, as a 'stick and carrot' to encourage action in soil policy in all EU Member States. We define a set of concrete and pragmatic actions and activities to be taken up locally or to share best practices which are already put into practice, but not yet widely known.

4. The HOW. This is what we should do

4.1 Put focus into action

The AquaConSoil community originally focused on contaminated land and groundwater management. This focus has broadened to include management of degraded land and area development where contamination solutions go hand in hand with restoring soil functions. This approach can help to meet societal challenges such as: the sustainable energy transition, climate adaptation and a healthy living environment.

At the AquaConSoil Conference of June 2021, a 10-point action plan was created, based on the presentations, workshops, discussions and exchange of experiences (see chapter 5). In this action plan we distinguish concrete actions which can contribute to the realisation of the EU Soil Strategy.

We distinguish four pillars of action:

1. Policy and economics
2. Research, development and innovation
3. Data transformation
4. Organisation, capacity building and social aspects

These pillars, with the exception of organisation, capacity building and social aspects are directly connected to the EU Soil Strategy (pillar 1), the EU Mission A Soil Deal for Europe, (pillar 2) and the EU Soil Observatory¹⁶ (pillar 3). In the AquaConSoil discussions it was agreed that there is also a need for organisational aspects such as capacity building and social aspects. This is our fourth pillar of action.



16. https://joint-research-centre.ec.europa.eu/eu-soil-observatory-euso_en

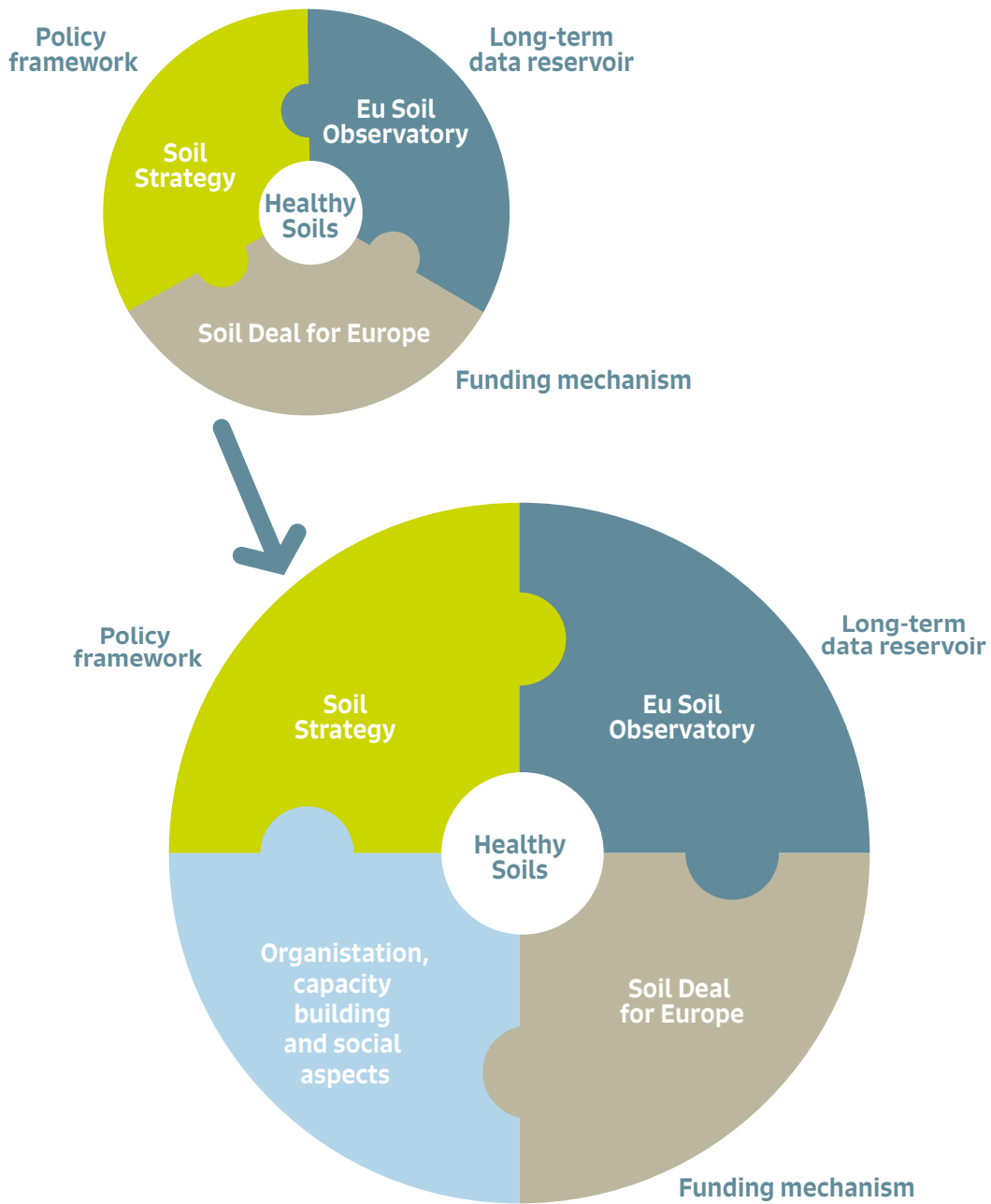


Figure 3 - Pillars of Action

The four pillars as described below are the authors' interpretation of the EU Objectives for the Soil Strategy (see paragraph 3.2) compared with the outcome of the AquaConSoil conference.

4.2 Pillar 1: Policy and economics

As interest in healthy soils is growing, so are pressures on soil. Interest in soil is needed to show the value of soils for society and hence convince politicians to protect soils and promote soil services. As healthy soils are a linking pin between economical welfare, health and societal challenges, such as adapting to and mitigating climate change, increasing biodiversity, securing healthy food and drinking water and transferring towards a circular bio-economy, soil policy makers should also make the connection with policies and strategies concerning these socio-economic transformations. Soil policy should support these transformations with a long-term vision document with goals and ambitions, a framework for restoration, sustainable use and management, guidelines, knowledge and ambitions taking into account that the interconnection of these challenges is only served with an integral and holistic approach. Aside from policy, multinationals and their stakeholders as well as the finance sector (pension funds, banks, private equity, insurance companies) should take responsibility towards future generations. They not only benefit from the earth's resources, but they should use their power and influence to play a prominent role in realizing a healthy environment, including soils.

If only approached in a sectorial way, the different challenges, compete for space and ecosystem/soil services. In a holistic approach, synergy can be found.

For example open soils in cities can contribute to healthy living, social inclusion, biodiversity and adaptation to climate change; sustainable agriculture can contribute to climate mitigation, biodiversity and healthy food and recreation at the same time. Not everything is possible at the same time and location as the soil-sediment-water system cannot deliver all services always and everywhere. Policy is necessary to secure that the soil-sediment-water system is taken into account in spatial planning and developments on national and even on cross country border level. It should be the basis for decisions on short but particularly for the long term. Policy should also provide the boundaries for sustainable use by a framework for restoration, protection and sustainable management. A good starting point for this could be the Doughnut Economy, a visual framework for sustainable development – shaped like a doughnut – combining the concept of planetary boundaries with the complementary concept of social boundaries¹⁷.

As soil is often privately owned it is a challenge to move owners towards sustainable management and to support public goals apart from their own interests. Therefore, policy should distinguish between setting the boundaries, providing knowledge and connecting stakeholders by showing opportunities for new business models based on a healthy soil-sediment-water-system. As already described in chapter 2, everybody should be able to live in a healthy environment.

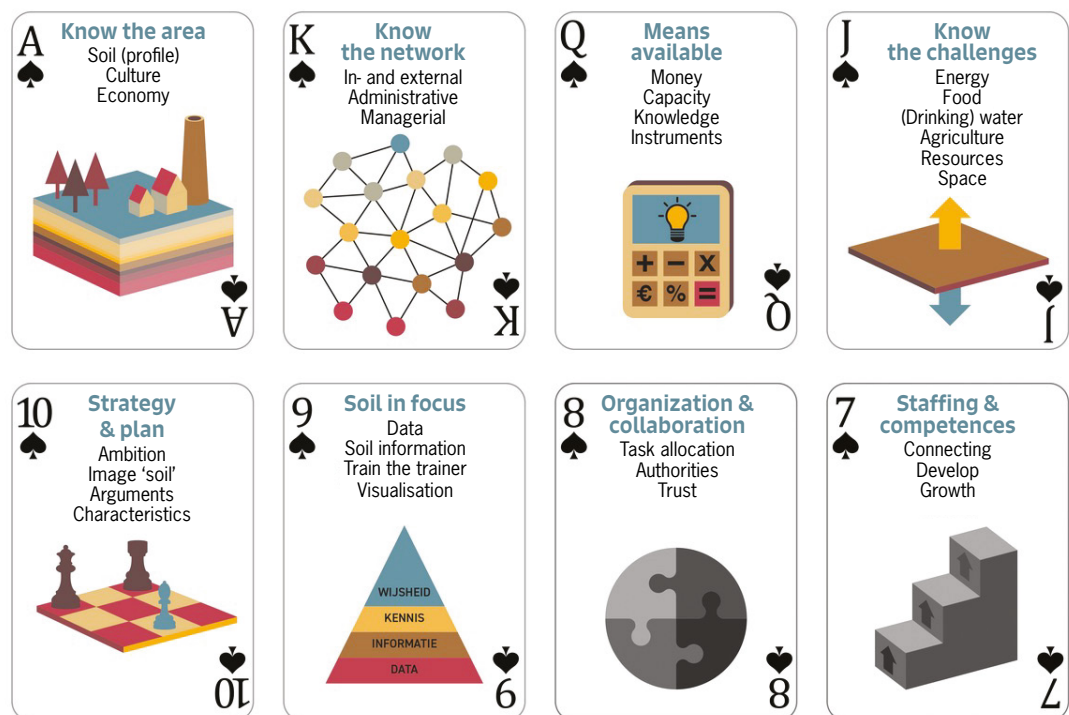
17. Doughnut (economic model) - Wikipedia

Not only we, but also future generations and people in developing regions. Research, development and innovation should be aimed at achieving this goal. The AquaConSoil outcomes already provided some perspectives for such an approach for example by introducing the concept of soil or land stewardship. At a minimum, the aspects mentioned below should be taken into account:

- Global change calls for political involvement. It requires giving the soil the attention it deserves as introduced in the SDGs and EU Soil Strategy. Another example is to involve soil ambassadors (as the Dutch soil ambassadors)¹⁸
- A holistic and interdisciplinary approach to achieving the SDGs
- A strong voice on soil
- A balance between supply and demand of ecosystem services and resources (= sustainable use or management to stay within the planetary boundaries)
- Circular use of soils, sediment and water and land

An example of a policy instrument demonstrated at the AquaConSoil conference, is known as 'Homework done'. This instrument was developed in the Dutch programme 'In Depth Together'. In this programme, regional authorities exchange experiences and insights to put into practise the Environment and Planning Act and research the role of the soil and subsurface in spatial development taking into account different societal challenges and stakeholders' interests.

Figure 4 - Homework done', a set of cards which form a common language to encourage interaction between different stakeholders with interests in soil and subsurface. Source: Samen de diepte in. <https://samendedieptein.nl/>



18. Plenary Assembly | Global Soil Partnership | Food and Agriculture Organization of the United Nations (fao.org)

4.3 Pillar 2: Research and development and innovation

In the field of research and development, a distinction is made between fundamental research, industrial research and experimental development and applied science¹⁹: In our holistic view we are convinced that if there is natural interaction between the various stakeholders in the field of research, the result will be better than if these domains act separately. This is not an easy job, but if we are able to organise pillar 1 (policy and economics) and pillar 4 (organisation – capacity building – social aspects) correctly, we can improve significantly. Long-term commitment, perseverance and investments are required, which are often a problem, while most politics and/or funding projects have a timeline of only four years. For example, on the topic of contaminated sites, politicians, academics and engineers have to be aware that given the fact that the inventory, assessment and treatment of contaminated sites sometimes takes decades, continuity in good, understandable, reproducible and transparent information management (data, reports, knowledge) is essential but often lacking. A good example of how to overcome this is the Commonland initiative²⁰, where participants are committed to land improvement initiatives for at least 20 years. This commitment is not in terms of financing but also in agreements of social participation and knowledge sharing. In our daily work we discovered that a dynamic approach of contaminated site issues can be accomplished and can accelerate when relevant stakeholders in politics, research, science and engineering join forces. In this aspect the EU Mission to establish 100 living labs and lighthouses to lead the transition towards healthy soils by 2030 can be beneficial. Practical examples which can be visited and discussed on what works and what does not, help others move forward. Lab-scale, pilot-scale and full-scale systems experiments, such as enhanced bio augmentation and bio stimulation techniques or DNA research in soil columns to investigate soil biodiversity stay important next to knowledge co-creation, as they help to understand the system and changes there in caused by (new) measures.



19. Onderzoek, ontwikkeling en innovatie (O&O&I) - Europa decentraal

20. Commonland - 4 returns from landscape restoration



Figure 5 - NICOLE Network for Industrially Co-ordinated Sustainable Land Management in Europe, booklet Land Stewardship²⁴

The AquaConSoil community already showed perspectives for such dynamic approaches. At a minimum, the aspects mentioned below should be taken into account:

- New research, together with stakeholders in the field by living labs and lighthouses
- Openness to new insights, like the Moonshot theory where complex problems are approached by aiming for radical solutions and disruptive technologies or the Doughnut Economy
- Instruments such as Land stewardship
- Use the power of the (soil) natural ecosystem (for example biomimicry, nature-based solutions (SoSeal²¹, RESANAT²², AquaConnect²³), circularity of resources)

21. SoSEAL (tudelft.nl)

22. Project - RESANAT (keep.eu)

23. AquaConnect - multi-disciplinary research to develop smart water-grids

24. Networks for Industrially Co-ordinated Sustainable Land Management in Europe (2020). *Land Stewardship - Investing in the Natural, Social and Economic Capital of Industrial Land*. Source: https://nicole.org/uploadedfiles/NICOLE_CF_Landstewardship_A5_Booklet_digital.pdf

4.4 Pillar 3: Data transformation

The world around us is changing rapidly. Digital developments play a very important role in this, not only in our private, but also in our professional life. The EU is well aware of this: digital transformation is one of the EU's priorities. The European Parliament is helping to shape policies to strengthen Europe's capabilities in new digital technologies, to create new opportunities for businesses and consumers, to support the EU's green transition and to help the EU become climate neutral by 2050. In May 2021²⁵, the EU Parliament adopted a report on shaping Europe's digital future, calling on the European Commission to continue to focus on the challenges of the digital transition. In particular, it calls for taking advantage of the opportunities of the digital single market, improving the use of artificial intelligence, as well as encouraging digital innovation and the development of digital skills.

In our opinion, data transformation is not a pillar on its own. It's the linking pin between all pillars. If you want to understand a system, to analyse trends, to evaluate the effectiveness of measures or policy, and when you want to communicate with stakeholders or citizens data and monitoring of data is essential. Therefore, it is important to develop indicators with the stakeholders. This guarantees learning and that the data are used to ameliorate policy and practices.

The AquaConSoil audience already shows perspectives for such an approach.

At a minimum, the aspects mentioned below should be taken into account:

- Increase the influence of data management
- Data, data and more data (Data Management, data collection, Artificial Intelligence, Machine Learning)
- Make digital technologies our (future) toolkit and an essential key in reducing the carbon footprint associated with site remediation works
- Develop digital twins of the physical environment to continuously monitor, predict and intervene

25. MEPs want more support for digital innovation and AI applications | Nieuws | Europees Parlement (europa.eu)

4.5 Pillar 4: Organisation - capacity building - social aspects

The value of soils as a means in private profit and societal challenges is being increasingly recognized. This leads to pressure on and competition over soil and land. To avoid a race to the bottom and prevent first-come, first-serve, not only interaction between the different users, policy makers and knowledge holders needs to be encouraged. Also those who use soils or use products with a soil footprint have to be encouraged to become a part of this interaction. This asks for education and information on the one hand, for example in citizen science projects²⁶. On the other hand, you need tools to get insight in the different interests of stakeholders such as a stakeholder readiness level tool²⁷. In addition to that you need a common language to exchange experiences and knowledge. But this is not enough. The projects as presented at the AquaConSoil conference show that successful collaboration is only possible when the different stakeholders trust one another. Like in the Flanders project on soil stewardship where, based on discussions with international experts, it became clear that trust is one of the conditions to come to long term agreements in sharing private property with other stakeholders²⁸. Other possibilities are the use of art in communication and addressing soil issues²⁹.



26. The University of Oklahoma Citizen Science Soil Collection Program (whatsinyourbackyard.org), Global Movement to #SaveSoil (consciousplanet.org), Onder Het Maaiveld - W-onderwereld (onder-het-maaiveld.nl)

27. Stakeholder Readiness Level tool (srl-tool.nl)

28. Soil+Land Stewardship (vlaanderen.be)

29. The Chronicle of Gaia - Carlijn Kingma, Museum of Edible Earth: Cuba - masharu

Additionally, it is necessary to create means to work in a more integrated way. New networks can help for example, the soil remediation network together with sustainable energy and spatial planning networks may obtain new combinations of techniques (groundwater remediation with soil energy) or realize the integration of soil functions in a spatial design. Because of the increasing complexity of managing our environment sustainably, authorities, but also scientists, have to change the way they work, not in silo's but in interdisciplinary teams. This requires different skills and training and capacity building.

The way we use soils and land has a long term-effect. Therefore, it's important to take into account the interests of future generations and secure the input of young professionals in long term visions and strategies. At AquaConSoil, young professionals showed that they feel responsibility, have valuable input and good ideas, by drawing up and sharing their ambitions for the EU Soil Strategy.

The AquaConSoil conference showed different perspectives for such an approach. At least the aspects underneath should be taken into concern:

- Create a global network of participants of science, companies, authorities and land owners with roots or interests in the soil-sediment-water-system
- Involve young professionals
- Improve soil literacy e.g. by art projects
- Build trust (public – private); create a common language

Margot: “This is a drawing which I saw in a local museum. The story behind this drawing together with the artwork and powerful imagination struck me. Everything in the drawing has a meaning. It’s a work of research and dialogue with different kind of people like policymakers and philosophers, who are each connected to the subject in a different way. Art is a strong means for communication which can also be used in the soil community to connect with other communities like spatial planners, the climate or health sector.”



Figure 6: Kingma, C. (2019). The Chronicle of Gaia³⁰.

30. Kingma, C. (2019). The Chronicle of Gaia. Carlijkingma.com. Accessed 6 December 2022 from <https://carlijkingma.com/The-Chronicle-of-Gaia>

5. Conclusions and 10-point action plan

5.1 Conclusions

With this Green Paper we want to show the larger context of the urgent necessity of a healthy soil. There is an incredible amount of work to be done. But it's doable. We want to take this up with the international soil and groundwater community. Crucial aspects in this whole process are four pillars, each with their own task, but unmistakably interconnected and with sublime cooperation between and involvement of politics, academia, industry and citizens. It starts with a long-term global vision (SDGs, EU Soil Strategy) to be translated into national and local policies. This is the backbone for implementation of legally binding measures. They must plea for sustainable solutions and embody social and economic aspects. We advocate for a dynamic approach between all stakeholders, local initiatives and knowledge sharing.

We hope you will be inspired to be as passionate as we are! We want to invite everyone who has a warm heart for a healthy soil, good ideas and a positive approach to go for it, to join this initiative for debate and discussion in politics and policy, but also for companies and their shareholders and the public to make this green paper a living document.

Sharing is caring: it's our dream to connect the ACS network with other networks to collaborate on local projects and exchange best practices. By doing this we want to contribute to healthy soils worldwide.



10-point action plan

1. Give soils a voice in decision making and actions

- Use **art as a language** to communicate and create awareness or involve other disciplines (i.e. philosophy)
- Education. **Teach the teacher**
- **Raise awareness** of the importance and find ways to engage them in sustainable land and soil-water-sediment-system use
- Holistic approach. Make restoration and preservation of **current and future soil functions** and biodiversity part of an EU Soil Health Law

2. Acknowledge the intrinsic value of soils

- Include **soil in the “Commons”** with air and water, in order to promote its health and prevent its degradation
- **Groundwater** should be fully included in the scope of the **Soil Strategy**

3. Transition in mindset and actions is crucial

- **Moonshot** approach
- Focus on **long term ambitions**, and avoid short-term economic decisions
- **Go for Green Transitions**, instead of Business as Usual (look, think and act differently)

4. Take responsibility, take control

- Stimulate cooperation with **Young Professionals**
- Connect **networks**, strengthen co-creation between communities and spread the message
- Build **trust** with society/citizens to science, regulators and industry

5. Set land degradation to zero

- Control urbanization: Minimize **soil sealing**
- Better **urban-rural balances**
- **Circular** use of soils, sediment and water

6. Programmatic approach soil remediation

- Develop a **guideline** for excavated soil (circularity)
- Define uniform **criteria for a healthy soil**

7. Connect soil with other societal challenges

- Climate, energy, food, urbanization, circularity
- **Interdisciplinary** focus
- **Perseverance** is key. The importance of long term ambitions, the future as dot on the horizon sets the scene for short term actions on all levels (global, regional, national, local)

8. New business models

- **Green Deals**
- **Land stewardship**
- **True pricing**, carbon credits
- **Multiple uses** of soil and land

9. New research and innovation models

- Co-creation with stakeholders
- Living labs and lighthouses
- Citizen science
- Translation from global- to regional- to national ambitions into local solutions
- Long-term social and financial commitment

10. Data, data and more data

- Monitoring
- Transparency
- Harmonization
- 3D/4D
- Machine learning (ML)
- Artificial Intelligence (AI)
- Visualisation

All information and presentations of the AquaConSoil 2021 can be found in the Book of Abstracts^{31 32}.

31. https://aquaconsoil.com/assets/Scientific-Programme/ACS2021_BookofAbstracts_incl-proceedings.pdf

32. Maring, L. (2021) *AquaConSoil 2021, recap*, Bodem 4 (in Dutch)