

4. ASSESSMENT OF THE CLUSTER SOIL SCIENCES

4.1. Organisation

The following chair groups are involved in the Soil Sciences cluster:

- Soil Physics and Land Management
- Soil Chemistry and Chemical Soil Quality
- Soil Biology and Biological Soil Quality
- Soil Geography and Landscape

In total, the cluster contains about 60 academic staff members (in fte's), of whom 44 are PhD candidates and 5 are postdocs.

4.2. Aims and strategy

The mission of the Soil Sciences cluster is to enable sustainable use and management of soil resources for reliable food production, improved quality of life and an environment that is resilient to climate change. The cluster strives for this by advancing understanding of the dynamic interactions between physical, biological and chemical soil properties and processes and of the impact of land use and management on soil health and ecosystem functioning.

The Soil cluster's strategy includes four main aims:

1. to be a world-leading academic group for high-impact research in the domain of its mission;
2. to generate and openly communicate science-based knowledge on sustainable soil/land management, serving multiple stakeholders from local to global;
3. to provide a world-renowned platform for research through a range of global knowledge networks and state-of-the art research facilities;
4. to develop the skills of new and current soil scientists (particularly in the early career phases), who will further enhance the cluster's mission and its contribution world-wide.

In the past six years, the cluster identified five research lines that it wants to focus on. Each prioritises a range of research topics, which are regularly reviewed. The research lines provide opportunities for joint action within the cluster, working together across chair groups through shared research projects and the co-supervising of PhD candidates. Each research line is led by two early-career researchers from different chair groups within the cluster to spur integration. The research lines are:

- soil-water interactions
- soil carbon management and climate change
- biodiverse agroecosystems
- multifunctional land evaluation
- nutrient cycling and contamination mitigation

The research lines relate directly to WIMEK's Grand Environmental Challenges, the United Nations Sustainable Development Goals, the UN Convention to Combat Desertification, the UN Environmental Program about Land Degradation Neutrality, the European Commission's Green Deal, and other policy and societal initiatives in the soil domain.

The committee finds that the Soil cluster has a clear mission that fits the cluster's recognised position as a global academic leader in soil research, teaching and impact. The research lines that have been identified align strongly with the WIMEK Grand Challenges and international policy, which is good. The committee also endorses the cluster's holistic approach that combines biological, chemical, physical and human interaction.



Less clear is the intended future destination and what success will look like in six years. The committee's impression from the self-evaluation is that the strategic aim is primarily to keep doing similar things but better, bigger and more integrated. The Soil cluster's strategy to date has primarily focused on improving the organisational structure, especially establishing the identified research lines as focal points of cluster strengths. The soil laboratories have also been re-structured and built into broader university facilities' organisation, and the cluster has found funding to keep them up to scratch. These are all necessary steps to strengthen the cluster and to keep its prominent position.

However, to get a stronger grip on the future and reinforce international leadership, the committee recommends a dedicated collective effort to set priorities and operationalize indicators and processes to assess how things are developing. This could for instance be done over a condensed period, involving key stakeholders and partners for reflection and advice. To optimize and facilitate the aforementioned strategy-building process, the cluster could consider asking support from the central university level.

By developing a sharper vision on the future, the cluster could become more agenda-setting in science and policy communities, in the committee's view. The committee recommends the cluster to be more outward looking. This should include identifying the major external drivers for soils research, looking beyond 2030. Soil will certainly play a central role in the continued development of solutions at the nexus of global challenges intersecting the climate crisis, food security, land degradation and water resources.

As an example, identifying big global challenges and ambitious solutions that will be required from interdisciplinary soils research post-2030 would provide the basis for a Theory of Change approach. Such an approach would help map the cluster's strengths (and gaps) against these future outcomes and identify pathways to develop the cluster and its partnerships, to fill gaps and to do what is necessary to deliver the solutions.

4.3. Research Quality

By leading a number of large international projects over the past six years, the Soil cluster has demonstrated its ability to act as initiator of multidisciplinary and transdisciplinary projects with scientists, governmental institutions, land user associations, farmers, NGO's and other relevant stakeholders. In these projects, the partners have jointly advanced the state of knowledge and solved problems on the ground, thus generating scientific and societal impact. These and other projects have resulted in many highly-quality publications that are often used by researchers within the field. In addition, various methods and approaches developed by the Soil Science cluster are being used by peers. Examples include an inclusive bottom-up approach that engages people in environmental stewardship and sustainable change, the freely available NINJA tool developed in collaboration with two other universities and used for calculating soil quality indicators, the SWAP model to simulate soil-water-plant processes and interactions and various soil chemical models.

The committee underscores that the Soil cluster of Wageningen University is one of the top research and student education centres of excellence globally in soil science. This is evidenced by the quality and scale of research outputs, the scale of research income, the critical mass of academic talent, and the scale and excellence of engagement with citizens, industry and government.

The quality of research output is evidenced by its use by peers, as shown in the citation metrics that the cluster provided. This shows that the average use of the cluster's research papers is more than twice the global average within the field. At least four of the cluster's papers are among the most influential papers in the field within the past six years. This quality is maintained at scale with peer-review publications at or approaching 200 per year during the past six years, which the committee deems impressive with less than 40 tenured staff members.

The cluster secured externally funded research grants and contracts with a value over €70 million over six years, which is exceptional considering the size of the cluster. The committee notes the predominance of academic staff



at early- and mid- career stages within the acquired grants, with 20 staff at assistant professorial and 'docent' level and a further 10 at associate professorial level. This staff profile across career stages has been largely consistent over the past six years, growing slightly for number of assistant professorial and professorial staff through appointments and promotions. This stable staff profile aligned with the publication and income track record indicates both a critical mass of excellence and a strong pool of talent for the succession of senior staff.

Particular strengths of the Soil cluster are the collective body of published work on soil chemical pollution and soil carbon management, particularly related to climate change and to soil health and land degradation. The cluster contributes substantially to major synthesis and agenda-setting studies, evidenced e.g., by the influential journal articles 'Soil quality – a critical review', 'Sensitivity of labile carbon fractions to tillage and organic matter management and their potential as comprehensive soil quality indicators across pedoclimatic conditions in Europe' and 'Modelling soil processes: Review, key challenges, and new perspectives'. This array of evidence supports the Soil cluster as one of the top soil science centres of excellence globally.

Since it is already very strong, the cluster does not need many recommendations on reinforcing its research quality. Nevertheless, the committee has one recommendation. It suggests that the Soil cluster could use and affirm its international stature by publishing a strategic paper on the role of soils in the UN's sustainable development goals. This would further strengthen the cluster's agenda setting role and confirm its international reputation.

4.4. Societal Relevance

The scale of the Soil cluster's societal impact is evidenced most clearly by the use of its research outputs in government and industry publications and other communications. This includes a total 186 publications for governmental and non-governmental organisations tackling major global and national societal challenges. The principal organisations citing the cluster's research output are those of the United Nations (primarily the UN Food and Agriculture Organisation FAO), but also the UN Environment Programme (UNEP) and the UN Educational, Scientific and Cultural Organisation (UNESCO). This indicates substantial standing and recognition of the cluster's research relevance and quality at global scale. Furthermore, over 80 publications and activities from the Soil cluster were covered by media in the past six years. Further evidence is provided in the SER appendices, noting many additional activities and outcomes with schools, citizens groups and companies including global and national corporate brands.

In considering further strategy development as suggested in paragraph 5.2., the cluster should challenge itself to be more ambitious on societal impact, in the committee's view. It should seek to provide global leadership to set agendas and influence research funding priorities, in order to ensure it is as relevant as possible to solving major challenges. The globally leading position of the Soil cluster and its strong relationships with the Dutch government, the EU and UN bodies places it in a uniquely strong position. It could and should, in the committee's view, deploy leadership activities that could build on this position. Examples are to build large coalitions and convene international strategy groups with global partners. Such coalitions could establish new vital directions of research, draft future destinations for soil science and solutions to global challenges, create roadmaps with government and industry for delivery of high impact outcomes, and synthesise evidence to support the funding for the proposed programmes. The cluster could strategically develop these ideas with key partners such as Syngenta, Joint Research Centre of the European Union, World Bank, FAO and UNEP. One approach could be to engage with selected closely collaborating individuals within those organisations and establish an external group to advise on how best to utilise the Soil cluster's strengths and range of national and global research and impact partnerships to create this type of global leadership.

Open science

From the documentation provided and the online site visit, the committee concludes that the Soil cluster is committed to and experienced in working openly and collaborating widely with stakeholders from local to global levels. This is a clear strength of the cluster. It is also good at reaching out to a wider public, as is evidenced by many



news appearances, some very well-attended MOOC's and original educational activities where researchers use earthworms in demonstrations.

Concerning open access publications and FAIR data management, the cluster fully supports and conforms to national and international requirements to increase accessibility of research output. Since 2015, it has realised a significant 128 per cent increase in open access publications. Presently, a total of 64 per cent of academic publications is open access. The committee sees evidence of a strong ethos and commitment to FAIR principles for data management, and an acknowledgement that there is more to do on this front. The FAIR principle is not fully adhered to yet in publishing research data. The committee recommends the cluster to act accordingly and strive for further progress towards full open access publishing and FAIR data management.

4.5. Viability

Future outlook

Given the outstanding position of the Soil cluster as described in paragraphs 5.4. and 5.5. and the prominent position of soil sciences in some of the world's largest challenges, the cluster's future looks bright. As stated above, the committee is convinced that the cluster can maximise its impact if it develops a sharper vision on the future and dares to be bolder in taking up international leadership roles. Importantly, while talking to staff members of the cluster at different levels, the committee sensed a true feeling of excitement about the future. This will be a powerful motor.

Academic culture

The Soil cluster values and strives to create an inclusive atmosphere for both the staff and the community of PhD candidates. From the documentation it has not become entirely clear to the committee what institutional mechanisms and practices are in place to support a positive culture for inclusion, safety and equality. The same goes for research integrity. The self-evaluation report mentions that the cluster finds research integrity important and that it fosters an open culture where staff members are able to discuss and address potential conflicts jeopardizing scientific integrity. However, details are not provided. Setting clear goals on this area might help ensure that research integrity is achieved in all domains of research. For inclusion, safety and equality the committee recommends not solely depending on an open culture but having some mechanisms that safeguard these aspects.

Talent management

The high scientific impact of the cluster builds on its successes in attracting highly qualified, motivated researchers from a diversity of backgrounds and nationalities. Hiring foreign staff has become easier since 2018, when the curricula of the most relevant undergraduate programmes became fully in English.

The committee found clear evidence that staff training, development, coaching, mentoring and career planning and support are well organised at the Soil Cluster. Staff retention looks very strong and provides stable leadership and group compositions.

As in many academic groups, the high-reaching environment and high workload may cause stress with PhD candidates and tenure-track staff. The cluster chair holders are aware of this, the committee found. They increased support to staff members, for instance with the coordination of large international research projects and programmes. This has lowered the workload somewhat.

Diversity

The Soil cluster values a diverse staff. In gender terms, the ratio at the level of PhD candidates and associate professors is balanced. At the level of full professors however female professors are strongly underrepresented (20%). Similarly, at the level of PhD candidates, the Soil cluster is very international, with more than half of the PhD students coming from abroad, but not so at the higher levels of the hierarchy. In the committee's view, targeted



measures are required to encourage the promotion of females and internationals to the higher-ranking functions of associate and full professors. This will balance the perspectives that are needed to connect with the outside world and make sure that all junior staff members and stakeholders feel that they are represented in the cluster's leadership.

4.6. PhD training and education

The committee got a very favorable impression of PhD supervision in the Soil cluster. Each PhD has two supervisors, and there is a buddy system. PhD candidates told the committee that they experience the cluster as an open, diverse research group with good social cohesion. The supervisors seemed to be aware of the importance of good supervision and coaching and they enjoy the supervision process. Some of the PhD teams of the cluster belonging to the individual chair groups meet every two weeks and there are additional PhD meetings and discussion groups, which likely benefits the good atmosphere. Various prizes and awards have been attributed to PhD candidates supervised by staff members of the cluster, which is more evidence of excellence in supervision.

The committee recommends guarding the balance in the ratio between PhD candidates and experienced staff, in order to keep up PhD supervision at the present high level.

