Strategic Research Assessment at TECH Faculty

Aarhus University

Department of Agroecology

For more information, see website here

Self-Evaluation Report

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Contents

1. Introduction to the department's history and development 3
1.1 Feedback from international evaluation in 2019 4
2. Societal context and departmental strategy 5
2.1 Agricultural context in Denmark 5
2.2 Departmental strategy 6
3. Departmental organisation and funding 7
3.1 Overview and department governance 7
3.2 Staff structure and development 8
3.3 Policies and practices promoting diversity and inclusion 9
3.4 Funding structure and development 10
3.5 Educational programmes 12
3.6 Public sector consultancy 12
3.7 Industrial collaboration 13
4. Departmental research environment 15
4.1 Research publications and quality 15
4.2 Societal impact of the research 16
4.3 Research infrastructures 18
4.4 Recruitment, on- and offboarding 19
4.5 PhD programme 20
4.6 Talent development 20
4.7 Work environment 21
5. Departmental strengths 22
5.1 Crop production and agricultural systems 22
5.2 Soils and emissions 23
5.3 Crop protection and biodiversity 26
6. Departmental development areas and challenges 27
6.1 Crop production and agricultural systems 27
6.2 Soils and emissions 28
6.3 Crop protection and biodiversity 29
Annex 1. Funding and staffing in AGRO 31
Annex 2. AGRO strategic themes and linkages to department sections 33
Annex 3. Scientific staff in AGRO research sections 34
Annex 4. Research sections in AGRO 35
Plant Pathology and Microbiology (PLANMIK, AU Flakkebjerg) 35
Crop Health (CROP, AU Flakkebjerg) 36
Crop Genetics and Biotechnology (CGB, AU Flakkebjerg) 37
Agricultural Biodiversity (ABD, AU Flakkebjerg, Aarhus) 38
Landscape Research in Sustainable Agricultural Futures (Land-CRAFT, Aarhus) 39
Climate and Water (KLIMA, AU Viborg) 40
Agricultural Systems and Sustainability (SYSTEM, AU Viborg) 41
Soil Fertility (JORNÆR, AU Viborg) 42
Soil Physics and Hydropedology (JORD, AU Viborg) 43

1. Introduction to the department's history and development

The Department of Agroecology (AGRO) is one of ten research departments in the Faculty of Technical Sciences (TECH) at Aarhus University (AU). The faculty also encompasses two centres (DCA and DCE) that facilitate policy support and external communication across the research departments. AGRO is affiliated with the DCA (Danish Centre for Food and Agriculture). AGRO conducts basic, strategic and applied research into the interaction between plants, soil, animals, humans and the environment within agroecosystems to produce food, feed, energy and biomaterials. It considers itself the nationally leading research institute within its area and among the internationally leading institutes in parts of its core area. AGRO aims to contribute to the green transition of agriculture within agroecosystems by creating, developing and transferring pioneering knowledge to promote sustainable agricultural systems as part of the greater bioeconomy. The department does this through excellent research, public sector consultancy and education.

The history of the department can be traced back to 1886 when agricultural research stations were initiated by the Royal Danish Agricultural Society with the aim of improving crop productivity in Denmark through research and experimentation. Due to the public demand and the high economic importance of agriculture, the work was transferred to a governmental institution in 1898. In the early part of the twentieth century, more than ten research stations were established throughout Denmark. Over time, additional activities were included, and the Danish Institute of Plant and Soil Science was established to integrate these activities.

In the 1970s, it was realised that agricultural research needed to span wider and use more advanced methods requiring new facilities and improved collaborations among researchers. Therefore, the National Institute of Animal Science and the Danish Institute of Plant and Soil Science jointly, in 1984, established Research Centre Foulum, now called AU Viborg. This meant closing several research stations and facilities across the country and moving activities and staff to Research Centre Foulum. Later, in 1986, the Danish Institute of Plant and Soil Science established a research centre in Flakkebjerg, now AU Flakkebjerg, which meant moving and closing several research stations and facilities related to crop production and crop protection. These two locations (AU Viborg and AU Flakkebjerg) host the major activities in the Department of Agroecology, including field and semi-field experimental facilities. Additionally, the department maintains research stations at Askov and Jyndevad. Askov hosts a long-term fertilisation trial that was established in 1894 and has continued uninterrupted since then, and Jyndevad also hosts valuable long-term experiments.

In 1997, the National Institute of Animal Science and the Danish Institute of Plant and Soil Science merged to form the Danish Institute of Agricultural Sciences. In 2007, this institute merged with Aarhus University and the Faculty of Agricultural Sciences was established. This merger was part of a national initiative to integrate the sectorial research into universities. Throughout the 2010s, significant structural changes took place and in 2020, the department became one out of ten departments in the newly established Faculty of Technical Sciences.

The Department of Agroecology is a result of the merger of several separate departments over time. However, it has largely maintained its current scope since the merger with Aarhus University in 2007, although a few research sections have joined the department since then. The department consists of nine research sections, field and laboratory facilities as well as a department secretariat located across the three locations of AU Viborg, AU Flakkebjerg and Aarhus. The research facilities in the department, which include field experimental sites, drones, laboratories, greenhouses, semi-field facilities, climate chambers, etc., are shared across the sections.

One of the nine research sections is Land-CRAFT, a pioneer center established in 2022 across Aarhus University and the University of Copenhagen with external funding. The most recent change in the department's structure was in the autumn 2024 when the section Agricultural Biodiversity (ABD) was formed by joining researchers in biodiversity in the agricultural landscape from the Department of Ecoscience with researchers in entomology and biodiversity from the Department of Agroecology.

1.1 Feedback from international evaluation in 2019

The feedback from the latest international evaluation of the department in 2019 centred on:

- Addressing more research questions internationally (the research outputs were mainly focused on research questions addressed within a Danish context)
- Introducing criteria for recruitment and promotion that value contributions to policy support
- Considering having a more defined career progression from postdoc to senior grades linked to competences
- Developing a strategy on how to improve the gender balance within the department
- Extending the excellent training elements of the PhD programme to early career researchers and including more training and experience in providing policy evidence and advice
- Creating a succession plan at management and employee level for replacing the large cohort of senior staff close to retirement

The department has largely implemented the feedback from 2019. After decades of stagnation and decline in funding as well as lack of opportunities for recruitment of new permanent staff, the situation changed from 2021 leading to massive growth in external funding and the recruitment of both permanent and temporary staff. The department is currently in a phase with a focus on slower growth, consolidation and capacity building. This focus includes strengthening competencies in research project management, data management, interdisciplinary collaboration and external communication. There has been and continues to be a focus on strengthening the leadership team in the department, both in terms of succession and in terms of building leadership competences.

2. Societal context and departmental strategy

2.1 Agricultural context in Denmark

Danish agriculture is in general highly intensive and export oriented, and it occupies 60% of the land area. It contributes considerably to nutrient loadings to the aquatic ecosystems with massive negative consequences for many marine ecosystems. Furthermore, it contributes about 30% of national greenhouse gases (GHG), and it has major detrimental effects on terrestrial biodiversity. These challenges have been realised for a long time and discussed heavily in the media and among politicians. Previous political agreements to resolve the challenges have failed to deliver action. Based on the need in legislation to reduce national greenhouse gas emissions by 30% in 2030 compared to 1990, it became clear in 2023 to both politicians and the farmers' organisations that the situation was not tenable. It was also clear to the farmers' organisations that they would be affected by very severe regulations unless they entered negotiations in a way that would deliver measurable results to relieve the situation. A tripartite dialogue was therefore initiated between the government, the farmers' organisation, the nature organisation, the food industry organisation, trade unions and the organisation of local authorities. This resulted in an agreement in June 2024, which was later adopted by the Danish Parliament.

The tripartite agreement (called Agreement on a Green Denmark) has five main aims: 1) reducing agricultural greenhouse gas emissions, 2) protecting aquatic ecosystems, 3) improving nature and biodiversity, 4) protecting groundwater for drinking water and 5) maintaining a competitive agriculture. These ambitions will mainly be achieved through three initiatives: 1) a CO2e tax on agricultural greenhouse gas emissions (initially focused on livestock emissions and emissions from cultivated peatlands), 2) a spatially targeted regulation of nitrate leaching from agricultural land with different allowable quota depending on tolerable levels of the aquatic environment and 3) land use change with an ambition of converting 10% of the total land area from agriculture to forestry and nature. The land use change will be supported by massive financial support from government and private foundations. This involves prioritising and identifying the land areas to be converted from agriculture to forestry and nature (including rewetting of cultivated peatlands). This prioritisation will be done at the local level in 23 local green tripartites with representation from government, local authorities and local farmers' and nature organisations.

The need to develop greener solutions for agriculture has for several years been obvious to many actors in the Danish agrifood system, including policy makers, regulators and the agrifood industry. This has provided funding for the department from both government and private foundations with a focus on the green transition of agriculture. The green tripartite agreement is of great importance for the department since this will further direct both research and policy support.

In addition to the focus areas of the green tripartite agreement, there is an increasing focus on soil health. The department is heavily involved in both research and policy support related to the *EU Soil Monitoring and Resilience Directive*, which is a legislative proposal aimed at restoring soil health across Europe. Introduced by the European Commission in July 2023, it seeks to establish a comprehensive framework for soil monitoring and sustainable management, contributing to the EU's broader environmental objectives.

The department has considerable research and policy support related to the sustainable use of pesticides and the development of alternatives, including Integrated Pest Management (IPM). Danish agriculture has

managed to greatly reduce its use of hazardous pesticides in recent years with the aim of protecting groundwater resources from pesticides and their residues. It is now clear that several key pesticides (herbicides, fungicides and insecticides) result in TFA (PFAS) residues that leach to the groundwater. This will call for an urgent upscaling of research in a range of preventive and protective alternative measures since a quick phasing out of these pesticides will have considerable negative consequences for major agri-food systems in Denmark.

2.2 Departmental strategy

Agriculture and agrifood systems are key to the green transition of society. The challenges are manifold and involve reducing greenhouse gas emissions, protecting biodiversity, protecting soil and water resources and ensuring food, energy and material security for a rising global population. The department's strategy focuses on supporting the green transition of agriculture through research, innovation, education, policy support, business collaboration and communication to society. The strategy includes eight focus areas:

1. Low carbon footprint farming: development of sustainable technologies and systems based on agroecological principles to reduce greenhouse gas emissions and resource consumption
2. Climate resilient cropping systems: research into robust cropping systems that can adapt to climate change and extreme weather conditions
3. Low pesticide-input farming: development of alternative approaches to plant protection and management at field and landscape level to reduce the use of chemical pesticides
4. Low nutrient emission farming: more efficient nutrient cycles and technologies to minimise the discharge of nitrogen and phosphorus to the aquatic environment and groundwater
5. Maintaining and improving soil quality: research into soil functions, biodiversity and sustainable tillage to preserve and improve soil quality
6. Sustainable digital-based farming: use of sensors, artificial intelligence and robotics to develop sustainable crop and cultivation systems
7. Farming for biodiversity: increased focus on biodiversity in the cultivated landscape and the benefits of biodiversity for agricultural and food production
8. Plant-based food: development and cultivation of plant-based food systems with low environmental and climate footprint

Meeting these ambitions requires a mission-oriented approach to research and innovation, involving a strong focus on interdisciplinary addressing the needs and barriers of all actors and stakeholders. This aligns well with the overall strategy of the faculty, and there is also a strong focus on collaboration across departments in the faculty and with the wider research and innovation environment in Denmark and Europe. The department sees this development continue and has therefore – in alignment with the faculty – a plan to continue this course in the new strategy cycle going from 2026 to 2030.

3. Departmental organisation and funding

3.1 Overview and department governance

The department currently has 392 employees – of which approx. 50% are academic staff. The scientific staff cover a wide range of competences, including biogeochemistry, plant physiology, plant molecular biology, plant biotechnology, crop science, soil science, soil physics, soil microbiology, hydropedology, soil fertility, soil nutrients, weed science, plant pathology, entomology, molecular biology, agricultural systems, irrigation, biodiversity, life cycle assessment (LCA), remote sensing and various aspects of modelling and social science. The department is organised into nine research sections and two experimental units (Jutland and Flakkebjerg) that manage four research stations (Fig. 1). The department is mainly located at three locations: AU Viborg (Foulum), AU Flakkebjerg and Aarhus. The educational BSc and MSc programmes were until 2023 solely located at Aarhus but are now being transferred to AU Viborg.

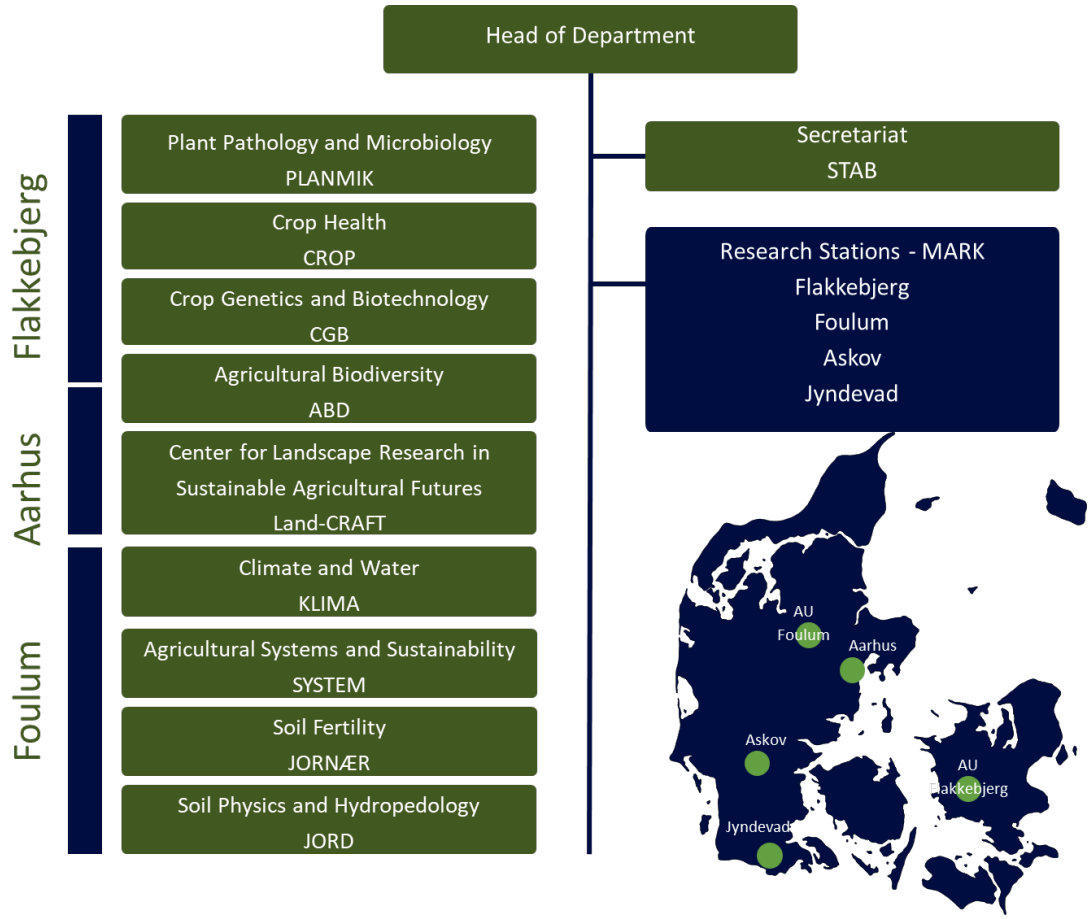


Figure 1. Organisation of the Department of Agroecology.

The department is governed by a leadership team comprising the head of department, two deputy heads of department (who also have a role as section leader) and the head of secretariat. In addition, the extended leadership team (AGRO Management) consists of seven head of sections and the two managers of the experimental units. The extended leadership team is supported by the university administration (in particular AU Economy and AU HR) and the deanship of the faculty. To ensure compliance with the University Act No. 960, the department has established several formal committees, which typically meet quarterly and have defined terms of reference and membership. Membership in these committees can be determined through formal voting processes or based on position, area of expertise or interest. These committees play a crucial role in the department's operations and democracy. In several cases, department committees are aligned with equivalent faculty committees. The department has in total 13 committees, which provide advice to the department leadership team on the following areas:

- Diversity and gender equality (DEI)
- Data management
- Laboratory and field equipment (three committees)
- PhD programme
- Degree programmes (two committees)
- Business and Innovation
- Research-based public sector consultancy
- Research
- Liaison
- Occupational health and safety

The committee chairperson takes part in meetings of the extended departmental leadership team. Several committee members also contribute to the TECH faculty committees.

The department’s core activities cover research, education and advisory activities, including public sector consultancy, and these activities are covered by a mixture of core funding and external funding. The department’s leadership team prepares staffing plans in collaboration with AU Economy based on the recommendation of the project managers. This ensures maximum transparency and optimal use of the department’s resources. These staffing plans are discussed with the head of sections four timers per year. Hiring of permanent scientific staff is based on recruitment plans made annually, whereas hiring of temporary scientific staff is based on funding plans for the individual projects and positions.

3.2 Staff structure and development

Since the international evaluation in 2019, the staff composition in the department have changed towards greater international diversity going from 59 international employees in 2020 to 151 in 2024 (Fig. 2). Through various means (including search committees), the department has focused on recruiting high-quality staff in all categories. There are currently 59 postdocs across the department and 84 PhD students, making AGRO the department in TECH with the largest population of PhD students and postdocs. There has also been a growth in permanent scientific staff and technical staff in the department (see Annex 1).

Most permanent scientific employees and all temporary scientific employees are employed partly or fully in externally funded research and innovation projects. These activities are supported by 147 technical and administrative employees. The department is going through a development with increasing staff diversity at all academic levels, with women occupying approximately 50% of all positions and with three women as part of the AGRO Leadership team, in line with the AU Action plan for gender equality, diversity and inclusion (Fig. 2). There is still a skewness towards male among the permanent scientific staff, but an equal gender distribution among newly recruited staff.

The department is committed to succession planning and promoting a balanced age distribution among its staff. The retirement age in Denmark is indexed but currently set at 67 years old, and the age distribution of seniors in the department has therefore been a concern (Annex 1). The department follows the faculty recruitment guidelines for open advertised calls, search committees for academic positions and meets requirements for a minimum number of qualified applicants and gender diversity. As an international work environment, the department embraces diversity and inclusion, with English as the main working language across the department.

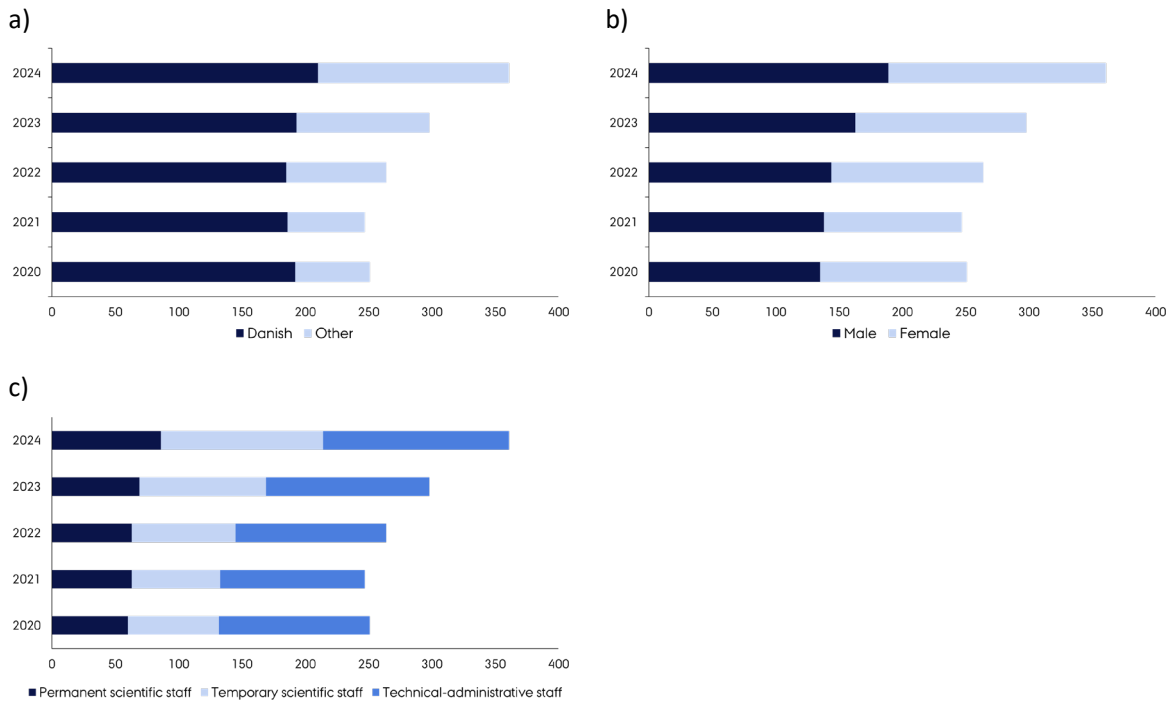


Figure 2. Number of employees. a) Nationality. b) Gender. c) Staff category (2020-2024).

3.3 Policies and practices promoting diversity and inclusion

The department has in recent years actively increased its DEI efforts. The diversity and inclusion strategies are integrated into all aspects of the department's operations, from recruitment and career development to the daily social culture. To promote a culture of awareness and understanding, all new employees are

encouraged to attend the AU cross-cultural workshop. AGRO has an action plan for DEI, focused on initiatives that include inclusion, awareness of unconscious bias, etc. The department supports diverse, interdisciplinary and gender-balanced project groups and work environments and advocates for transparent career development. The department is concerned with having a balanced gender and diversity in leading positions to encourage diversity among role models.

3.4 Funding structure and development

External funding amounts to 58% of the income in the department (Fig. 3). The remaining 42% comes from the public sector consultancy contracts with the Danish government, core research funding from the university and a small portion for educational activities. There are small additional incomes from sales and commercial activities. The core funding for research and public sector consultancy is used as co-funding of research activities largely aligned to the priorities set by the public sector consultancy activities. These activities include providing ongoing advice to the authorities, solving specific tasks from the authorities and carrying out the underlying research. The core funding for research-based public consultancy has been declining by about 2% per year for almost 20 years and continues to do so, although some compensation has been given in the past two years.

More than half of the department's expenses are salaries for the staff (Fig. 4). Internal contributions include costs associated with AU central activities, including rent, buildings and administration. The depreciation covers investments in equipment that is depreciated over time.

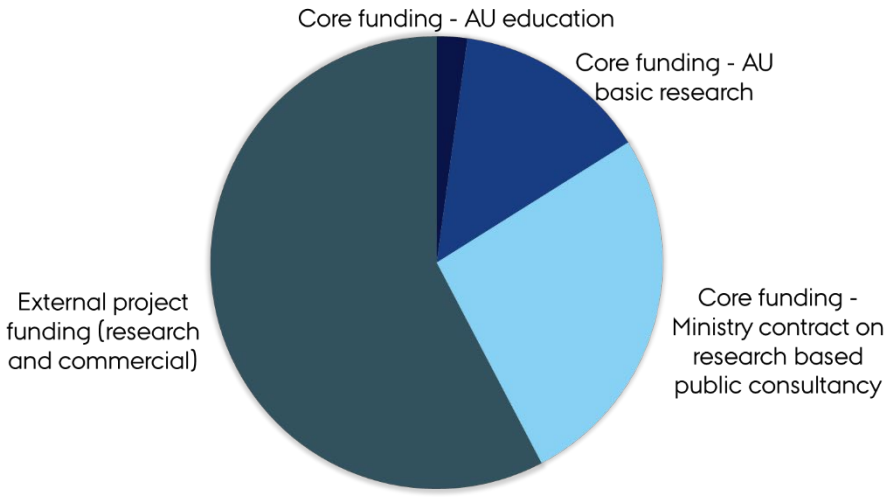


Figure 3. Sources of income for the department in 2024.

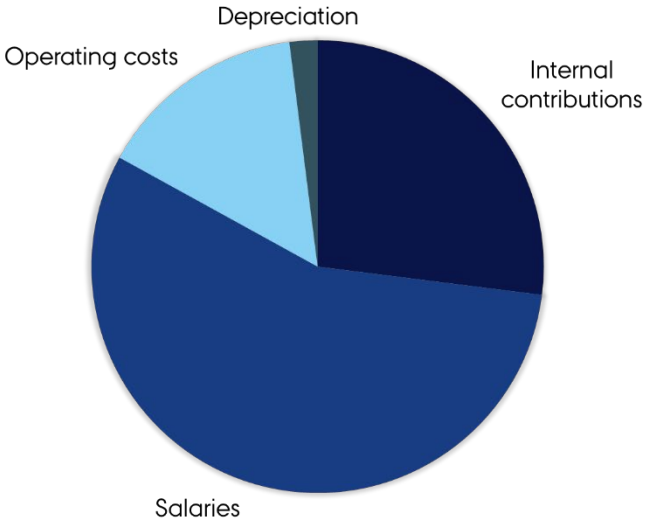


Figure 4. Expenses in the department in 2024.

There are several sources of external research funding (Fig. 5). The Danish public funds include research grants for basic research (research councils), policy-related research (government agencies) and innovation (e.g. Innovation Fund Denmark, GUDP, levy funds). Danish private funding includes various grants from foundations, such as the NNF, Villum and Carlsberg. EU funding primarily includes Horizon programme and ERC grants. International grants relate to grants from other foundations, such as the Welcome Trust and the Gates Foundation. Over the period 2020-2025, both the total number of applications and the granted amounts have been increasing (Fig. 5). This is largely based on a funding strategy that supports the department's ambitions within the agricultural green transition. These grants are typically achieved in partnerships with research and industrial collaborators.

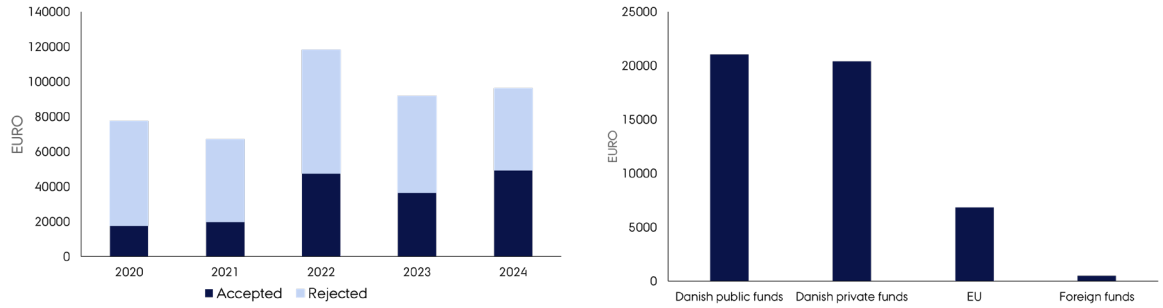


Figure 5. Overview of applied and granted amounts in external research applications from 2020 to 2024 (left) and distribution of granted applications in 2024 (right).

The increase in acquired external funding shown in Fig. 5 over the period 2022 to 2024 exceeds the increase in spending, since these grants cover several years into the future. However, spending of external funding increased from 17.9 to 27.7 million € over the period 2022-2024. A large part of the increasing

spending is related to temporary scientific staff (PhD and postdoc). The increase in external funds includes personal starting grants and awarded grants based on excellence. Since 2022, the department has secured nine starting and recruiting grants for international staff joining the department.

To support the research funding, a funding team anchored in the department's secretariat was established in February 2024 to address the growing complexity and volume of the department's project portfolio, covering both pre- and post-award activities. The department's researchers receive ongoing information on relevant funding opportunities. The team facilitate internal idea development, supporting the formation of consortia, and assist researchers with proposal writing and strategic planning. Finally, in addition to hands-on support, the team provide training and sparring on application writing and guidance on understanding the scope and strategic intent of call texts and help researchers navigate the requirements of funding instruments. The department research funding team are supported by the TECH Research Support Office (TECH RSO) and the AU Technology Transfer Office (AU TTO).

3.5 Educational programmes

Following the integration of the department into Aarhus University in 2007, it has, since 2008, offered undergraduate and graduate degree programmes in collaboration with the Department of Animal and Veterinary Science and the Department of Food Science. These programmes were initially established at the main campus in Aarhus. The core of the programmes consists of a bachelor's degree in Agrobiology, with specialisations in food science, animal science or plant and environmental science. Graduates of this programme have had the opportunity to pursue further studies through an international master's degree programme in Agrobiology, including specialisations in animal science, agronomy and environment, crop nutrition and health or organic agriculture.

In accordance with a political agreement in 2021, a strategic decision was made to gradually relocate the educational programmes from the campus in Aarhus to the campus in Viborg. As part of this transition, a new BSc programme in Plant and Food Science was started in 2024 in collaboration with the Department of Food Science. This programme offers two specialisations: food science and plant and soil science. Beginning in 2027, this will include an international MSc programme in Plant and Soil Science.

The department has, since 2019, participated in the Erasmus Mundus Joint Master's Degree programme *"International Master in Soils and Global Change" (IMSOGLO)* in partnership with three other European universities.

3.6 Public sector consultancy

The department provides policy support for several ministries in Denmark:

- Ministry of Food, Agriculture and Fisheries
- Ministry of Green Transition
- Ministry of Environment and Gender Equality
- Ministry of Climate, Energy and Utilities

The contacts to the ministries are organised through the DCA and the DCE (Danish Centre for Environment and Energy) at Aarhus University. The DCA and DCE are thus the entry points for the ministries to the research departments in TECH. The DCA maintains the framework agreements with the ministries in collaboration with the departments within food and agriculture. TECH has implemented a quality assurance system for all public sector consultancy that ensures quality and transparency of the advice for both the public and the private sector.

Although the number of advisory tasks has remained stable over time (Fig. 6), these tasks are becoming increasingly complex, requiring collaborations across departments in TECH and with other national institutions (e.g. the Geological Survey of Denmark and Greenland (GEUS) and the University of Copenhagen). They are also increasingly becoming dependent on data from a wide range of sources, including farm-based registrations, remote sensing and soil samplings. There is a need to integrate these data in order to provide relevant advice, and modelling of different types, including statistical models, simulation models and various forms of AI, are being implemented. Denmark is very well organised in terms of comprehensive data from field/farm to catchment scales, and these data are well integrated into modelling schemes that are also increasingly used for regulatory purposes and included in the advisory tasks. These applications in advisory activities are often well integrated and supported by research projects.

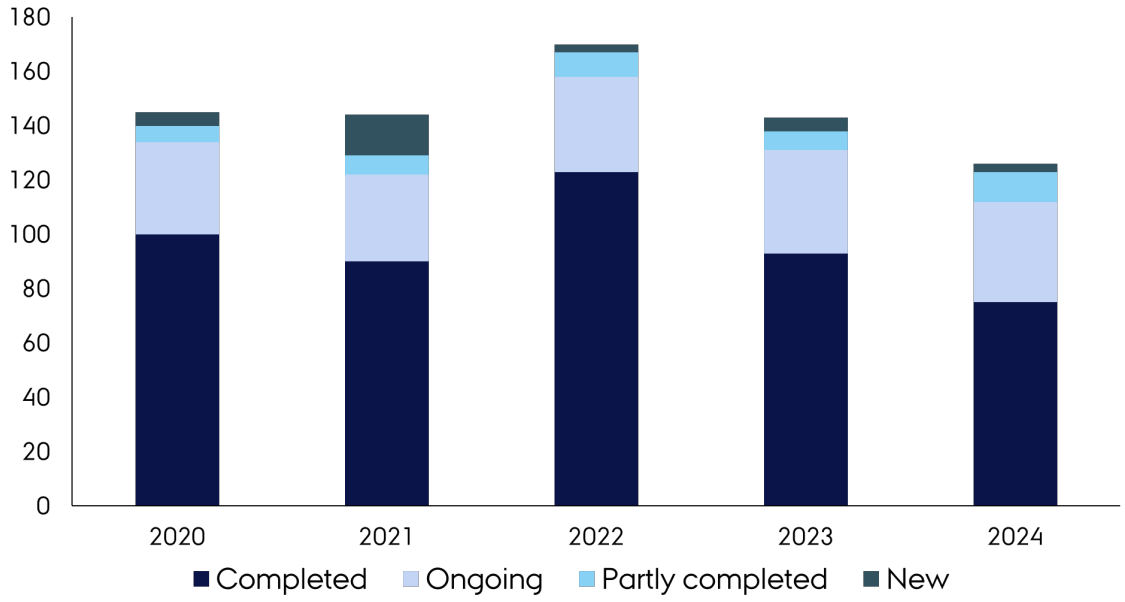


Figure 6. Number of advisory tasks for the ministries, 2020-2024.

3.7 Industrial collaboration

The department collaborates extensively with business partners to foster implementation of research findings in the agrifood sector. Business partners provide cofunding in projects, direct funding or contributes to the training of industrial PhD and postdoc staff. These collaborations are integrated across all sections in the department and across all themes in the department's strategy. The business collaboration is partly anchored with agrifood industry clusters in Denmark (e.g. AgriFoodTure, Food & Bio

Cluster Denmark (FBCD) and Crop Innovation Denmark), specific industry collaborators (e.g. SEGES Innovation, DLF and FOSS) and ongoing collaborations between senior research staff in the department and a multitude of private companies and organisations. There are additional European-scale activities, such as EuroBlight and EuroWheat, supporting collaborations between researchers in the department and potato and wheat breeding companies to develop host resistance and hence reduce pesticide use. An emerging business area is green biorefinery where AGRO is involved in developing optimal management strategies that tighten nutrient use, reduce nitrate leaching and store soil C. Its impact on product footprints is assessed and utilised in LCA's, which are highly valued by companies.

The department had projects with partners from the industry for 9.8 million EUR in 2024, and the projects are distributed over several topical areas (Fig. 7).

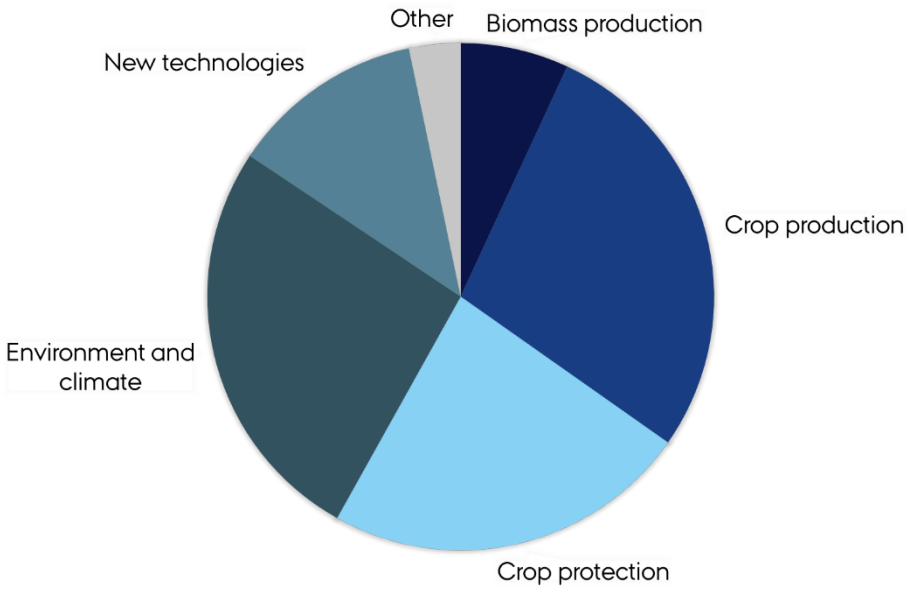


Figure 7. Departmental collaboration with industry within designated areas.

4. Departmental research environment

4.1 Research publications and quality

The primary research is published in international peer-reviewed research publications, primarily in Q1 journals. From 2022-2024, the department published 823 publications, an average of 4.5 peer-reviewed publications per senior academic employee. Of these, 63% were open access, and 63% were in the top 10% journals (as defined by CiteScore), with an increasing rate of publications in the highest impact journals (Fig. 8).

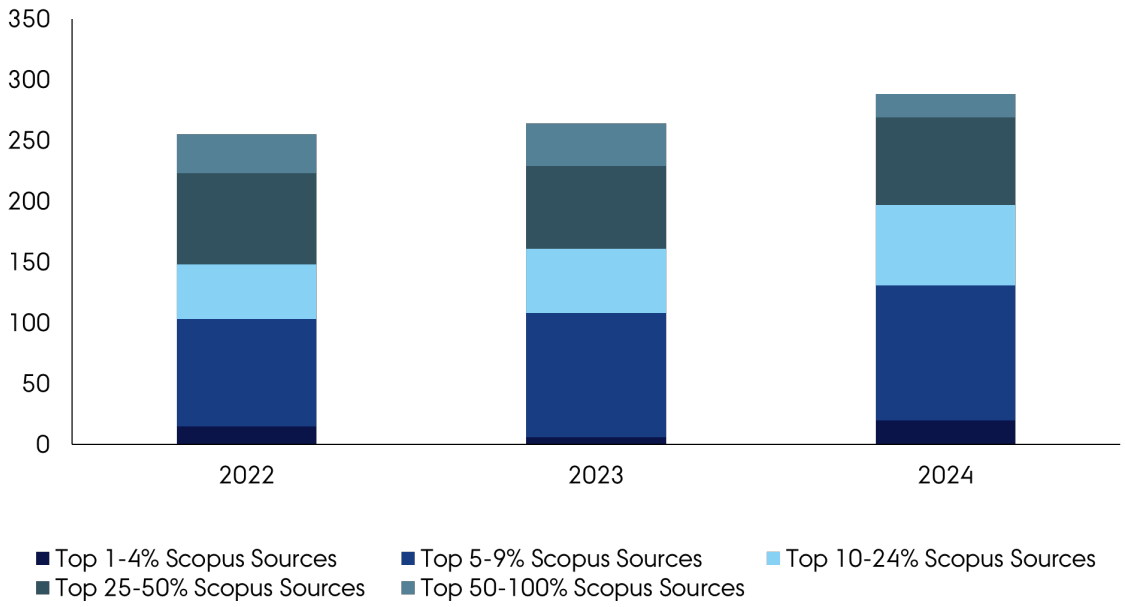


Figure 8. Number of publications related to journal percentiles (according to CiteScore).

Of the 2022-2024 peer-reviewed publications, 79% had international co-authors. Only 0.6% were single authorship. There were 4.4% publications with co-authorship from industry. The field-weighted citation impact was 2.1 for the papers with international co-authorship and 1.1 for the rest.

The senior scientific staff cover staff categories such as tenure track assistant professors, senior advisors, senior researchers, associate professors and professors. They have different responsibilities and scientific profiles and work within different scientific disciplines with different publication traditions. This is reflected in different scientific impacts of their publication profiles (Fig. 9). Six members of the senior scientific staff have an h-index above 50.

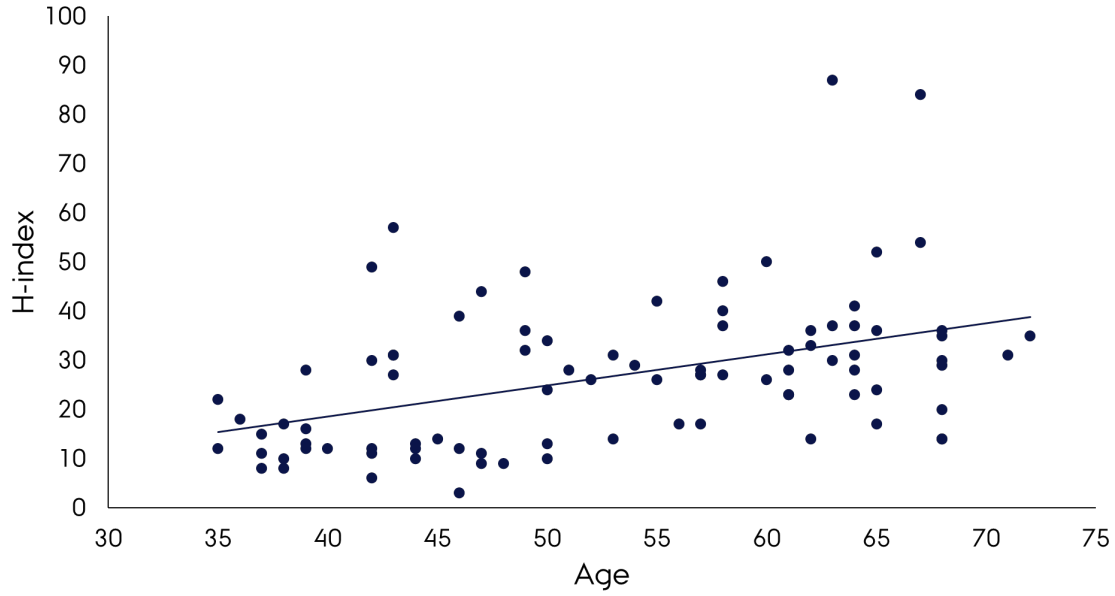


Figure 9. H-index for senior scientific staff, spring 2025.

4.2 Societal impact of the research

The department aims to contribute to the green transition of agriculture and food systems. In the end, the research activities should therefore be measured in terms of their contributions to the transition processes. Such contributions are difficult to quantify, so here only some examples will be given with reference to the themes in the department's strategy.

Low carbon footprint farming

The research has been developing improved methodologies for accounting GHG emissions from agricultural activities, which have been incorporated into national emissions accounting schemes as well as into farm-based accounting such as that applied by the company Arla. These methodologies include accounting for soil C changes (C-TOOL model), revised emissions factors for nitrous oxide and methodologies for accounting for GHG emissions from manure management. The research has also developed new technologies for reducing GHG emissions, such as measures to reduce methane emissions from manure management, and for reducing nitrous oxide from agricultural lands.

Climate resilient cropping systems

Research has previously focused on identifying key challenges of agricultural systems to climate change and variability. The focus has recently shifted towards adaptation and resilience building. This is seen in the collaboration with plant breeders and the seed industry, where the department has a long-term collaboration with DLF, which now is one of the world's leading providers of grass seeds, and which now is focusing on climate reliance of the varieties developed.

Low pesticide-input farming

The department has a long-standing activity in efficacy testing of chemical pesticides and other plant protection products in collaboration with the agrochemical companies and increasingly with biocontrol companies. The department has also developed various IPM strategies that together with development of model-based advisory systems have reduced pesticide consumption in Denmark drastically. This also included the development of a new pesticide load indicator that is used for incentivising less harmful pesticide use. The department collaborates with GEUS in maintaining a network of sites for monitoring the risk of pesticide leaching, which is used for safeguarding against contamination of groundwater.

Low nutrient emission farming

Losses of nitrogen and phosphorus from agroecosystems in Denmark have long been major contributors to eutrophication of freshwater and marine ecosystems and pollution of groundwater for drinking water purposes. This has been a research area for the department for more than three decades, and the department has developed knowledge, data and models to quantify and map the sources and developed measures to reduce the losses. It has also contributed to developing working governance structures to implement measures, and these are now being implemented through the green tripartite agreement.

Maintaining and improving soil quality

Soil quality and soil health have many facets, and several sections of the department contribute to quantifying and mapping aspects of soil health. The department holds the national database on soils and has been developing new soil maps based on linking various data sources. These maps are used by both the farming industry and by regulators.

Sustainable digital-based farming

Linking various data sources on soil, crops, weather and other aspects with proximal sensing has been ongoing activities in the department for more than two decades, including development of algorithms for precision fertilisation and crop protection. This has supported the introduction of more sustainable farming based on precision technologies.

Farming for biodiversity

The organically farmed area in Denmark has increased to 12%, partly due to considerable research efforts to strengthen productivity and sustainability aspects of organic farming. Research in the department has also shown that this has benefited biodiversity in the agricultural landscape, and the department has developed biodiversity indicators to steer this development better in the future.

Plant-based food

The department has contributed in various ways to the development of plant-based foods. It has developed the basis for sustainability assessments of foods, using LCA. Furthermore, it has developed management for improved sustainability of food crops. It currently contributes to developing new legume protein food crops and it also uses New Breeding Techniques (NBT) for developing new food crops.

4.3 Research infrastructures

The department maintains a range of research infrastructures that support the research and that also underpin the research-based public consultancy. The research infrastructures can be categorised into three categories: physical, databases and models. In practice, they are often interdependent. The research infrastructures in the department are open to external collaborators (both research and industrial), typically based on collaborative projects. A non-exhaustive list of some of these infrastructures is given below.

Physical infrastructures
The department maintains farmland for field experimental activities at AU Viborg, AU Flakkebjerg, Askov and Jyndevad. Some of this land is allocated to long-term field trials covering aspects such as fertilisation, liming, organic farming, conservation agriculture, perennial cropping, crop residue management, biochar and agrivoltaics. Many of the long-term experiments are used for monitoring carbon and nitrogen fluxes. The department has additional field experimental sites, such as 1) sites for rewetting of drained peatlands (ReWet research infrastructure), 2) the Danish Pesticide Leaching Assessment Programme (PLAP) with six experimental sites in collaboration with GEUS and 3) sites for assessing efficacy of constructed wetlands for reducing nitrogen and phosphorus loadings in collaboration with the Department of Ecoscience.

Semi-field facilities are available at all four field experimental sites. They typically include lysimeters and facilities for pot experiments. Some of these lysimeters are also used for long-term experiments, e.g. with C- or N-labelled materials. AU Flakkebjerg and AU Viborg also have greenhouses and climate chambers for controlled experimentation. Some of these facilities are approved for disease or GMO containment.

Modern laboratory facilities are available at AU Viborg, AU Flakkebjerg and Aarhus. They cover aspects such as soil physics and chemistry (including a new soil spectral laboratory), soil nutrients and microbiology, plant pathology and biotechnology and gas measurements linked to various ‘omics and use of isotopes.

The department maintains a portfolio of field measurement equipment for proximal sensing of soils and crops, including drone-mounted sensors of various types, and for measurement of carbon and nitrogen fluxes (solutes and gases). These instruments are used both at the field experimental sites and wider in Denmark and Greenland.

The department maintains several unique soil and biological archives for use in research, including 1) soil samples from soil classification campaigns dating back to the 1970s and long-term field experiments dating back to the early 1900s (at AU Viborg and Askov) and 2) the global repository of cereal rust fungi (with the Global Rust Reference Center (GRRC) at AU Flakkebjerg).

Database infrastructures
The department maintains several databases essential for both research and policy support, including:

- Data from various soil sampling campaigns, including re-samplings to monitor changes
- Data on crops and soils from long-term experiments
- Data on nitrate leaching from field experiments
- Data on global rust diseases in agricultural crops
- Data on farm management at farm and partly field scale from all Danish agricultural land

- Data on efficacy of crop protection agents

Model-based infrastructures
A range of statistical models and simulation models are being applied across the department. Some of these models were developed in the department and are being maintained, including ALMASS, NLES and CTOOL. Other models are being used in the department and some of them codeveloped with other institutions in Denmark and internationally, including Daisy, LandscapeDNDC and APSIM.

Data support functions
The department hosts experts (mostly technical staff) within data management, data science, statistics and general data support. We are currently working across the department to visualise competences and to coordinate tasks and strategic development needs. The need for coordination has increased in recent years with the growth of the department and with increasing needs for data transparency (FAIR principles). The present suggestion is to rethink the current Data Management Committee from an advisory group into a working group partly financed by basic funding in the department and partly through external projects. The aim is to build a strong departmental data research infrastructure. The department has hired a data steward to ensure that research data across the department are captured, stored, organised, documented, exchanged, shared, published and preserved in compliance with legislation, etc., but it is a task that needs to build on a fundamental infrastructure for it to be a success.

4.4 Recruitment, on- and offboarding

All communication and processes regarding recruitment are handled in the secretariat, which coordinates with AU HR, the head of department and the head of section or field manager who wishes to recruit a new employee. The extended leadership group discuss the recruitment plan for the permanent scientific staff for the following year. Process plans are available for how the department recruits different staff categories. Once a new employee has been offered employment, there are onboarding programmes designed to meet the needs of new colleagues. New employees receive information about who their buddy is. This is an experienced colleague in the research section who is extra focused on welcoming the new colleague. As part of the onboarding for junior research staff (postdocs, assistant professors), there is an alignment of expectations conversation with the head of section and the supervisor with the purpose of welcoming and introducing them to the next stage in their academic career. For tenure track assistant professors, this follows a more formalised approach with the involvement of the head of department.

The department has recently implemented a pilot mentor programme for postdocs. This programme has been developed by a group of postdocs and senior scientific staff to support early-career researchers' professional development and well-being at the department. The mentor has no formal role in relation to the mentee (e.g. as supervisor, project leader, head of section). Through mentoring meetings, the mentors offer their time and presence for confidential sparring and guidance on work-related topics and issues.

Furthermore, the department offers career days at both AU Flakkebjerg and AU Viborg with the purpose of providing information on the different career path opportunities for young researchers. For some, it is meaningful to stay in academia, while for others, the private sector or government bodies call for their

expertise. At termination of a position in the department, the line leader offers an offboarding conversation to gather feedback and understand the reasons for leaving and gather insights to improve the working culture in the department.

4.5 PhD programme

In the Danish system, PhD students are typically employed for three years, and at AGRO they are enrolled in the Graduate School of Technical Sciences (GSTS). The financial plan for a PhD student is for approx. 0.2 million EUR in salary, plus 32,000 EUR in tuition fee, with additional consumables and travel costs typically being funded from an aligned externally funded project. With its currently 84 registered PhD students, the Agroecology PhD programme is by far the largest PhD programme under the GSTS. All research sections in the department are engaged in PhD education. The supervisors have all attended the GSTS supervisor course, and the PhD programme has, since 2024, recommended to run yearly supervisor brush-up courses. The PhD programme aims at organising four to five high-level PhD courses per year, and this is expected to increase. Most sections are active in providing PhD courses, and, in general, the courses are well used by both the PhD students in the department and students from other universities across Europe.

The PhD students are included in the scientific and social environment of the department. Additionally, several initiatives are related specifically to PhD students. These initiatives have been established and improved over the years:

PhD buddy scheme**:** The buddy scheme was established in 2007 on request from the PhD students. The list of tasks was made by the students, and it is continuously updated to reflect the needs of the students. The purpose of the buddy scheme is to make new students feel welcome and to make sure that they become a part of the scientific and social life of the department.

Introduction meetings for new students: Four times per year the PhD programme runs introduction meetings for new PhD students in the department. The meetings contain information about department PhD initiatives and things to be aware of in connection with doing a PhD in this department and in Denmark in general.

Well-being conversations: Well-being conversations were implemented in 2015 and have since been part of the PhD programme committee's tasks. The conversations are held twice a year between one of the senior PhD programme committee members and the student. The purpose of the conversations is to give the student room to discuss topics with a person who is not involved in the PhD project. The student sets the agenda and decides which topics should be discussed. It is mandatory to participate in the talks, they are confidential, and no minutes are taken. It is possible to book more conversations if needed.

4.6 Talent development

Clear career progression is important within the Danish system and supported within the department. In the Danish system, postdocs can be employed for a maximum of four years at any one Danish university, and assistant professors are also limited to a period of four years. Only a small percentage of the postdocs

in the department will have future permanent positions within the department, and the department therefore provides support for diverse career pathways.

Postdocs are invited to individual career coaching sessions with their head of section, focused on fostering their professional development and career advancement. Tenure track assistant professors are part of a structured faculty tenure track programme designed to ensure professional development to meet the requirements for associate professor.

All scientific staff involved in teaching are required to complete AU's University Pedagogical Programme. Additionally, AU offers senior academic staff competency development through various teaching skills programmes provided by the AU Centre for Educational Development (AU-CED). For staff involved in research-based policy advice, attendance at a course on research-based policy advice is mandatory. Furthermore, AU provides comprehensive training on leadership for all heads of section as well as a six-month training on Mission-Oriented Research and Leadership for all tenure track employees and associate professors.

4.7 Work environment

To support the professional development and well-being of all staff, annual staff development dialogues (SDDs) with immediate line leaders are prioritised as an essential part of the dialogue between staff and their line leaders. This is supported by the Liaison Committee and the Committee on Occupational Health and Safety, who also are responsible for following up on the workplace assessments.

The department encourages staff to be part of departmental committees, in raising their voice and in supporting their colleague's safety and psychological safety in the work environment. The department prioritises the quality of the work environment and is committed to foster a dynamic and supportive environment for its staff. The department organises an annual two-day meeting for all research staff, where technical staff participates every second year. This is to foster cohesion and collaboration within the department. In addition, short (one-hour) department meetings are organised every month (physical or online) to ensure that department staff are well informed. Further information is provided on an internal website and through biweekly newsletters sent by email.

The various recruitment and onboarding processes aligned with structured dialogues either individually or in groups are designed to enhance personal well-being, professional development and help staff navigate their career and work life, depending on how life shifts course sometimes. The department encourages all staff to interact and contribute by taking a collective interest and responsibility in research activities, talent development, knowledge exchange, teaching and policy advice. Active participation in the department's work environment is expected and valued.

5. Departmental strengths

The department has over time cultivated a strong tradition of collaboration supporting cross-sectional and interdisciplinary collaboration. The department recognises that addressing complex societal and scientific challenges requires integrated efforts that transcend disciplinary boundaries. This ethos is reflected in the formation of joint research initiatives and coordinated policy advisory groups that bring together researchers across disciplines. Over time, these collaborative structures have become embedded in the department's culture. Regular interdisciplinary theme days, cross-sectional research activities combining academic expertise with technical insights, contribute to this deep integration across functions and hierarchies that sustain research excellence and relevance. Furthermore, research-based policy support is by nature a collaborative effort merging expert knowledge from multiple disciplines. This collaborative working culture has for decades been a cornerstone for the department, where projects are often characterised by involvement of several senior scientific employees, often with joint supervision of junior scientific staff. This collaborative culture needs to acknowledge the importance of individual disciplinary skills, capacities and achievements, where especially our early career researchers must define their own specialisations while also contributing to joint research and innovation activities. The challenge for the organisation is to secure a good balance between collaborative and individual research to secure the maintenance of this stronghold, which is critical for ensuring societal relevance of the department activities. Leadership within the department acknowledges this and supports transparent governance structures and open channels for communication. Decision-making processes often include input from all career stages, ensuring that research initiatives are both top-down supported and bottom-up driven.

Here, we present the department's strongholds within three main areas that cross several research sections: 1) crop production and agricultural systems, 2) soils and emissions and 3) crop protection and biodiversity.

5.1 Crop production and agricultural systems

Within crop production and agricultural systems, we foster an innovative research culture and maintain strong interdisciplinary and industrial collaborations, positioning us as a key contributor to the sustainable transformation of agrifood systems. Our expertise spans climate and environmental impacts at both farm and landscape scales as well as throughout the value chain. Moreover, we have significant strengths in the social sciences, particularly in the development, implementation and overcoming of barriers in the green transition of agrifood systems.

The research is focused on crops relevant to food and feed production and to some extent for biomaterials. We have strong platforms in crop genetics and biotechnology, precision agriculture, cereals, grain and forage legumes, grasslands, biorefining, responses to drought and flooding, system approaches (such as environmental impacts at landscape level), life cycle assessment and social science. We work on both high-tech approaches, such as agrivoltaics and digitalised precision systems, as well as agroecological approaches, such as organic and perennial systems and regenerative practices. We conduct end-to-end value chain projects from developing plants in the laboratory, field optimisation and crop resilience to estimation of climate and environmental footprint and stakeholder analysis on transition challenges. We

often act as a bridge between disciplinary fields, including linking livestock, plant science, plant breeding and engineering.

Research is focused on different areas of the cropping systems, where sensors, models and development of digital twins are applied for research, e.g. on roots and perennial cropping systems, to agronomic management and into soil health. Several digital projects are also engaging the private sectors in both joint funded activities and demonstration days. We take the lead in strategic and technology-driven research, with expertise in both recombinant and non-recombinant molecular technologies. Our infrastructure integrating laboratories, greenhouses and field facilities supports development of resilient crop traits (including NGT readiness), plant breeding for climate resilience and crop-based solutions to environmental challenges. We are involved in several externally funded activities aimed at using novel technologies for improving sustainability of agricultural fields (SPEARS, Novocrops, BarleyMicroBreed). Finally, we also reach out to the general public (e.g. through lectures/demonstration in schools, public events, etc.).

We embrace a shared systems-thinking approach that encourages cross-disciplinary collaboration. Our strong research infrastructure, strategic partnerships and proactive adoption of next-generation technologies position us well for tackling major societal challenges. Our research has a significant societal impact, particularly through research-based policy advice. This includes applying LCAs in climate labelling of food and contributing to broader agricultural policy frameworks. We are also a key European partner in areas such as practice-oriented on-farm research (Living Lab approach) and agricultural landscapes. Examples of this are our engagements in two EU strategic partnerships – Agroecology and Future Foods. We also have core competencies within organic farming, reinforcing our commitment to sustainable and innovative agrifood systems. Other examples include the SmartField project and leadership roles in AgMIP teams. We maintain a strategic collaboration with private companies (e.g. DLF, Arla) maximising the practical impact of our research.

We are actively involved in interdisciplinary collaborations through participation in interdisciplinary centres (e.g. iCLIMATE at AU and START in Denmark), national research infrastructures (e.g. ReWet) and European platforms (e.g. AnaEE, AgroServ). Our work bridges multiple departments in TECH, fostering synergies across agricultural, environmental and social sciences. We have a dynamic mix of early career and experienced researchers. Our tenure track assistant professors and postdocs have demonstrated success in attracting highly competitive external funding, such as Sapere Aude and Marie Skłodowska-Curie fellowships, indicating strong prospects for the future. Researchers are consistently included as co-applicants and co-authors on collaborative projects, reflecting a highly inclusive and cooperative research culture.

5.2 Soils and emissions

The research into soils and emissions focuses on the interactions between crop growth, soil fertility and nutrient and organic matter turnover in agroecosystems, aiming to enhance nutrient use efficiency, reduce GHG emissions and nutrient losses and protect long-term soil fertility. We study key processes (such as nitrogen and phosphorus cycling, GHG emissions and nutrient synchrony, across various agricultural systems), using lab, field and modelling approaches.

A strong emphasis is placed on soil's role in food security, climate regulation and environmental health, supported by novel methods for measuring, modelling and mapping soil properties and health indicators.

Using platforms such as LandscapeDNDC and remote sensing, we assess sustainable land management strategies – such as rewetting, optimised fertilisation and cover crops – at multiple scales. This biogeochemical research is closely integrated with socioeconomic analyses and stakeholder engagement to support resilient and sustainable agricultural systems.

Our strengths are the interface of agriculture, landscapes and the environment, contributing to a sustainable agricultural future aligned with Denmark's green tripartite agreement and 2030 climate goals. This is supported by PhD and postdoctoral research, e.g. with the newly developed model MARTINIS, which is a low-cost, real-time, in situ imaging system using planar optodes to monitor microscale soil oxygen, pH and ammonia dynamics, offering new insights into how spatiotemporal soil conditions influence GHG emissions. In collaboration with the University of Copenhagen and the Karlsruhe Institute of Technology, we identified nitrogen isotopic signatures as effective indicators of N_2O emissions and nitrate leaching from field to catchment scale. Using detailed land management data, we validated the LandscapeDNDC model for estimating nitrogen budgets and losses, highlighting the importance of data aggregation. We also created a scalable framework combining citizen science images, satellite data and explainable AI to detect crop and residue conditions across the EU, enhancing agroecosystem modelling. A global meta-analysis of cereal production showed that wheat has the highest yield-scaled N_2O emissions, with regional differences largely driven by climate and soil factors rather than fertiliser use.

Another strength is the plant-soil-microbes interactions driving both crop productivity and soil health development. We are at the forefront in developing methodologies for non-destructive and destructive root studies using advanced metabolomics and isotopes as tools to increase our understanding of root exploration of the soil volume and the cycling of primary and specialized metabolites. We have experts in the studies of short-term plant input of carbon to soil, and the resulting effects on soil organic matter pools, and further we have long-term field experiments allowing studies of cropping system effects on soil organic matter fate. Our field-based studies are instrumental to generate high-quality data for our soil organic matter dynamic modelling contributing to overall assessment of cropping system management on sustainable agroecosystems.

Our academic network spans national and global institutions, including universities, private research centres and vocational schools. Collaborative projects such as the NNF-funded SmartField highlight our applied focus on reducing nitrogen losses and emissions. Looking ahead, we aim to expand partnerships in AI, remote sensing and sensor development and to become a global leader in modelling greenhouse gas budgets at the landscape scale. A key priority is ensuring that our research remains relevant and accessible through ongoing stakeholder engagement. We maintain and develop strong collaborations with industry partners, advisory services and international companies across business sectors, such as dairy, fertiliser, robotics and biogas.

We contribute heavily to Aarhus University's research-based policy support contract with the Danish ministries, especially around GHG emissions, nutrient emissions, mitigation options, soil health and soil mapping. This is evidenced by a very large number of assignments from the ministries. The key scientific questions are focused within subjects relevant within relevant subjects, and consultancy reports are with few exceptions based on work published in peer-reviewed international journals. The sections have a strong international position with extensive international collaboration and researchers coordinating several European Joint Programme (EJP) Soil and Mission Soil projects. We participate actively in international fora,

such as the European Soil Partnership and the Global Soil Partnership under FAO as well as the European Joint Research Centre. Our research has consistently been published in leading scientific journals within our area of expertise.

Over the past few years, our research environment has undergone substantial staff changes due to recruitment and retirements with a notable increase in professors and early-career researchers, including tenure track assistant professors, postdocs and PhD students. We have expanded the young researchers' groups and increased technical support staff.

5.3 Crop protection and biodiversity

The research in crop protection and biodiversity addresses natural and agro-ecosystems and the transition to a more environmentally sustainable agriculture through a broad, yet focused, approach encompassing pests, weeds and disease management, landscape-scale ecology and plant-microbe interactions. We integrate advanced digital technologies and embrace socio-economic dimensions of sustainability.

We are internationally recognised for our leadership in plant and environmental microbiology. We explore the roles of viruses, fungi, bacteria, archaea and nematodes in ecosystem functioning and crop resilience. We are at the forefront of research into plant genetic regulation of microbiome assembly and microbiome feedback on plant phenotypic plasticity. Integrating state-of-the-art high-throughput sequencing methodologies (genomics, metagenomics and transcriptomics) with additional 'omics methodologies, notably plant metabolomics, we seek to identify molecular mechanisms underlying the impact of microbiomes and microbial taxa on plant phenotypic and ecosystem responses.

We have developed the innovative ALMaSS landscape model, which simulates the individual-based dynamics of vertebrate and invertebrate populations, together with the distribution in time and space of land usage, crops, pollinator resources and pesticide loadings. We are responsible for the Global Rust Reference Center (GRRC) and the global wheat rust data management platform WheatRustToolbox, a generic and online database-driven information system. Besides, we hold a worldwide repository of >30,000 stock isolates of rust fungi, a unique resource for targeted phenotyping for rust resistance in plant breeding and research within host-pathogen interactions. The GRRC receives and characterises samples of rust-infected wheat year-round from epidemic sites in any country in the world, which is essential for wheat rust early warning.

We have a long tradition of optimising weed and disease management to reduce chemical pesticide use and of research into the fundamental weed biology and fungicide chemistry, herbage seed production, seed science, natural product chemistry and environmental chemistry. Weeds, pests and diseases have traditionally been controlled using chemical pesticides, and we have been the leading partner in developing alternatives. Our goal towards low-input pesticide farming and further towards a pesticide-free agriculture has led to new aims in our applications and new goals in our projects. We are currently involved in projects with image-based weed recognition and spot spraying, mechanical weed management and the use of lasers together with more traditional methods like row establishment and intercropping. Research areas related to beneficial plant-microbe interactions for production of healthy crops, natural product chemistry and environmental chemistry are also some of our research highlights.

We study biodiversity as both an ecological service and a public good. Denmark's national reference laboratory for honeybee health, is accredited under the latest ISO standards and plays a key role in European bee health monitoring (e.g. COLOSS).

We maintain close collaborations with breeders, crop physiologists, technology developers and farmer networks. Our work informs EU regulatory science (via EFSA) and supports rapid implementation of findings in policy and practice. Our strength lies in transdisciplinary innovation – linking agronomy, microbiology, ecology and sociology to achieve a climate resilient and economically viable agriculture.

6. Departmental development areas and challenges

While AGRO possesses significant strengths, there are also challenges that could impede long-term potential if not addressed. This, we have described below for the same three research clusters as in the previous section.

6.1 Crop production and agricultural systems

Weaknesses

There is a lack of coordinated research data infrastructure for large-scale data processing, including limited server access, inadequate storage and fragmented software tools. We also struggle to generate added value from field data. One of the core issues is the fragmented integration of empirical data into broader research outputs. While we generate significant amounts of high-quality data – particularly from field research – we are not fully capitalising on their value in terms of synthesis, analysis and application. This reduces our ability to influence high-level research policy and societal impact outcomes. While we have been successful in attracting funding for large research infrastructures, there is often a gap in operational funding needed to apply these tools meaningfully within ongoing research. Without this next step, the potential of such infrastructure remains largely untapped, and the intended benefits for interdisciplinary research cannot be fully realised. In terms of research operations, resource harmonisation is insufficient, and technical bottlenecks hamper productivity. An example of this is that we have a shortage of drones and only a few staff members qualified to process drone images, which significantly slows progress in terms of data collection, analysis and, ultimately, publication or application of results. Projects that depend on timely remote sensing or aerial data may face delays or incomplete datasets. Another issue is that our research into plant-based foods, though promising, is currently too sporadic and lacks the critical mass needed to build a strong and recognised profile. A more focused and strategic effort is required to position this work in alignment with broader food system transitions. Our reliance on specific technologies such as NGTs also presents a vulnerability. If regulatory or societal barriers delay or prevent the practical application of these technologies, we risk being overly invested in an avenue that cannot deliver a timely impact.

Threats

There is a need for more experienced researchers to take on leadership roles. We have a small number of senior scientific staff, many of whom are burdened with administrative and policy support tasks, which limits strategic research leadership and mentorship. For young researchers, there is concern regarding their future roles, especially in developing new, forward-looking research profiles. Despite being vital to interdisciplinary collaboration, they often lack leadership opportunities and training and face pressure to perform and lead early in their careers. Furthermore, reliance on collaboration, while a strength, can also become a weakness when partners or support structures are lacking. At times, our internal systems fall short in facilitating this integration. The limited number of Danish-speaking young researchers present challenges for engagement with key national stakeholders, such as farmer representatives and public authorities. The contributions to policy support activities are often under-recognised academically, making it

harder to involve and motivate junior staff. Another threat is the complexity of the stakeholder landscapes. It is difficult to clearly identify and prioritise potential partners for collaboration. This is compounded by the challenge of securing funding for truly interdisciplinary projects, which are often undervalued or poorly supported by traditional funding structures despite broad academic and societal interest.

Opportunities
We are well positioned to make a significant impact, particularly by contributing to the development of new sustainable crop production systems and of policy frameworks grounded in systems thinking. The Danish research narrative focused on research-based, interdisciplinary solutions continues to gain recognition on the international stage, and we see several promising opportunities – particularly "low-hanging fruits" – in the green transition. These often require interdisciplinary collaboration in areas such as the food-energy-water nexus and climate-smart agriculture. Our increasing diversity in skills, culture, age and gender within the department further strengthens our capacity to engage in such collaboration, both nationally and internationally.

6.2 Soils and emissions

Weaknesses
We have data and infrastructure limitations when it comes to the long-term experimental data at the research stations in Jyndevad, Askov and Foulum (AU Viborg). The current infrastructures are underdeveloped and based on solid knowledge and experience from senior staff but are not following current best practices within data organisation and data management. With a limited data infrastructure, there are also limited possibilities for integration and collaboration with the industry, including having industrial PhD students. Furthermore, it limits our possibilities for having interdisciplinary collaborations. Investments in building a comprehensive research data infrastructure are necessary if we are to secure long-term experimental data for future research. Another investment need refers to remote sensing, advanced sensor techniques and isotope laboratories if we are to maintain a leading position. We have a strong emphasis on nitrogen and on intensive agriculture, particularly annual crops. On the other hand, there is a lack of strategically focused and coordinated long-term efforts in researching novel measures to reduce nutrient losses and emissions. We have a strong national focus rather than international focus on a global challenge, and there is a low visibility of our international collaborations because our global perspective is limited. This narrow scope limits the department's influence on the international stage, which reduces the department's broader societal impact. Finally, there is a challenge towards establishing and succeeding with deep interdisciplinary research collaborations. Focus is still on technical sciences with rare approaches towards other disciplines that could benefit our exploration of alternative systems or broader agricultural themes.

Threats
Currently, there is a positive political momentum for supporting our research, but we know that when political leadership changes, so can funding priorities. One threat to be aware of is the integration of the next generation of researchers, including internationals, into policy support in general and policy support

tasks. Our young researchers perceive policy support work as professionally limiting, academically invisible, career-wise uncertain and politically sensitive. At the same time, there is a lack of clear structures for recognition, career development and academic freedom within the area. Another threat is the lack of resources for sustainable growth of the number of permanent senior level scientific staff. This undermines both the short-term functioning and the long-term vitality of the academic environments. We lose leadership and institutional memory; we weaken the research quality and capacity with the risk of brain drain, and our junior researchers depend on mentoring. Without a critical mass of senior staff, there is a risk of low supervision and stalled development. Finally, a lack of coordination at department and section levels is experienced. Lack of coordination creates inefficiency, misalignment and fragmentation**,** ultimately weakening the department's ability to deliver high quality research.

Opportunities
The national and international funding bodies have the green transition on their agendas. Even though political winds can change, we do not expect that this will happen in the near future. We experience a national and international push for interdisciplinarity, and the green transition and green tripartite agreement are drivers for interdisciplinary research. We must see interdisciplinarity as a lever for academic depth and societal relevance. Therefore, we could approach it as a progress learning journey from PhD to tenure track level. Students and junior researchers should have collaboration as key learning goals; first with closely related programmes, then across sections, departments, faculties, etc. Another opportunity could be to create clear career pathways that are targeted at policy support, where we build further from the policy support course they take and offer additional courses within policy processes, ethical decision-making and policy communication supplemented with promoting good examples of impactful government advisory work in the public and academic arenas.

6.3 Crop protection and biodiversity

Weaknesses
Our capacity for fundamental research in pest (weed, diseases, insects) biology is currently limited, primarily due to insufficient core funding. This also affects our ability to take on leadership roles in EU-funded projects. While we are active participants in both basic and applied research across Denmark and the EU, the lack of stable funding makes it difficult to invest in essential infrastructure, such as laboratory instruments, field equipment, long-term experiments and living labs. Securing major grants would significantly strengthen our foundation, enabling us to make these critical investments and build long-term research capacity. Technology and data science are already integral to many of our projects. Strengthening our expertise in sensor development, machine learning and software engineering would allow us to stay at the forefront of innovation.

Research into resilient plant production is restricted by the lack of advanced climate control systems, e.g. facilities for applying controlled drought treatments at greenhouse, semi-field and field scale. This restricts our means of testing, e.g. microbial-aided drought resilience, at relevant scales. Likewise, lack of high-throughput plant phenotyping facilities limits our ability to assess measures and treatment effects on above- and belowground plant traits. In the current situation, plant phenotyping is conducted manually,

and this sets clear limits for the number of plant parameters and treatments that we can realistically handle.

Threats

Attracting experienced researchers to the field of pest (weed, diseases, insects) biology remains a challenge, largely due to the limited number of students entering this discipline globally. This shortage of talent is compounded by increasing competition for research funding and growing expectations for collaboration with companies, farmers and other stakeholders. However, such collaboration can be difficult to establish when there are no immediate economic incentives for partners. The focus on limited use of synthetic chemical pesticides and implementation of technology in farming are two examples of areas where the economic incentive is limited for farmers. Another pressing concern is the declining funding from contract research and policy support activities within pest control, with further reductions likely. These resources are essential for sustaining our core research, and continued cuts risk undermining our long-term capabilities. To maintain our leadership in the field, it is crucial to secure funding for long-term field experiments and living labs. These investments would not only strengthen our research infrastructure but also foster broader collaboration across the agricultural value chain. Such partnerships are vital for contributing for participation in large-scale national and international projects.

We have strong competences within plant microbiology, but we are also facing strong national and international competition within this field. This field is highly data and technology driven, and insufficient funding of and access to high-throughput sequencing and multi-omics infrastructure as well as extensive computational power could set our lead position at risk. The lack of facilities and expertise for working with new invasive quarantine pest species hampers our ability to provide research-based advice on the regulation and management of emerging pests likely to occur from climatic changes.

Opportunities

Our research addresses key challenges in future agriculture and plays a vital role in the green transition of society. We are expanding our focus from IPM to Integrated Crop Management (ICM), deepening our understanding of soil and plant processes and advancing digital solutions for both farmers and authorities. These areas present exciting opportunities and complex challenges, which we are committed to tackling. Fortunately, several funding opportunities are available, and our tenure track researchers bring strong competencies that enable them to lead projects independently or in collaboration with more experienced researchers. Our policy support is particularly important in evaluating the effectiveness of non-chemical pest management strategies. This area also offers great potential for interdisciplinary collaboration, especially in understanding the broader societal impacts. As agriculture and regulatory bodies increasingly adopt new technologies, we see a valuable opportunity to strengthen our partnerships with companies, farmers and their organisations. One area where we see clear room for improvement is in the development of decision support systems for farmers. Enhancing our capabilities here would greatly improve the implementation and real-world impact of our research.

Annex 1. Funding and staffing in AGRO

Academic staff

Table 1: Job category (FTE)	2022	2023	2024
Professor	15	19	23
Associate professor	37	35	36
Tenure track / assistant professor	18	22	39
Total senior academic staff	**70**	**76**	**98**
Postdoc	38	46	51
PhD student	31	36	47
Total academic staff	**139**	**158**	**196**

Staff diversity

Table 2: Gender composition (percentage of females)	2022	2023	2024
Senior academic staff	28%	29%	31%
Postdoc	43%	47%	54%
PhD student	51%	56%	55%
All job categories	**41%**	**44%**	**47%**

Table 3: Age (average per job category)	2022	2023	2024
Professor	58.7	60.2	58.7
Associate professor	57.5	55.4	56.2
Tenure track / assistant professor	41.3	41.2	41.2
Postdoc	35.0	36.0	35.2
PhD student	30.8	30.2	29.5

Table 4: Citizenship (percentage of non-Danish citizens) *	2022	2023	2024
Senior academic staff	24%	33%	42%
Postdoc	75%	83%	88%
PhD student	71%	75%	79%
All job categories	**57%**	**64%**	**70%**

*International staff include 46 citizenships

Publications

Table 5: Scholarly output	2022	2023	2024
Number of publications	261	269	293
Number of publications per senior academic employee	3.7	3.5	3.0

Table 6: Science-based policy advice	2022	2023	2024
Number of publications	113	116	97
Number of publications per senior academic employee	1.6	1.5	1.0

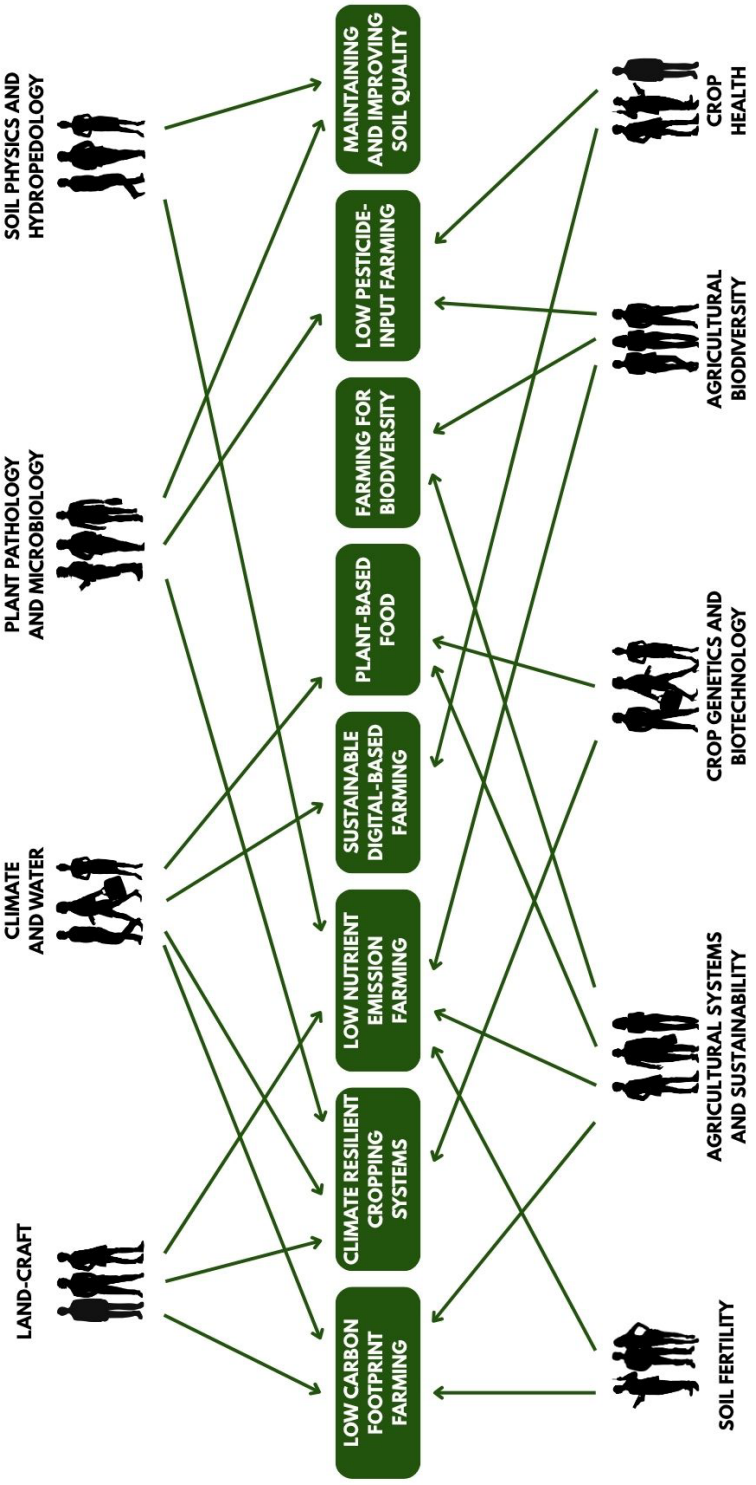
Funding

Table 7: Funding by category (in 1000 €)	2022	2023	2024
Education	1,225	1,171	1,047
Basic (performance based)	3,991	4,665	6,669
Ministry (research, capability and infrastructure)	7,173	7,170	7,319
Ministry (policy advice)	5,216	5,154	5,261
External project funding (research and commercial)	17,943	21,394	27,665
Total	**35,548**	**39,554**	**47,961**

Table 8: External project funding by category (in 1000 €)	2022	2023	2024
EU	1,935	2,509	5,220
Private	3,458	3,654	4,035
Public	12,550	15,231	18,410
Total external funding	**17,943**	**21,394**	**27,665**
Total external funding per senior academic employee	**0.256**	**0.282**	**0.282**

Table 9: Educational revenue (in 1000 €)	2022	2023	2024
Educational revenue	1,225	1,171	1,047
Educational revenue per senior academic employee	**0.018**	**0.015**	**0.011**

Annex 2. AGRO strategic themes and linkages to department sections



Annex 3. Scientific staff in AGRO research sections

Number of academic employees per section (June 2025)

Section	Professor	Associate professor*	Tenure track / Assistant professor	Postdoc**	PhD student	Total
Plant Pathology and Microbiology	4	1	5	8	8	26
Crop Health	3	6	6	3	6	24
Crop Genetics and Biotechnology	1	3	2	5	2	13
Agricultural Biodiversity	1	6	2	5	1	15
Center for Landscape Research in Sustainable Agricultural Futures - Land-CRAFT	2	0	1	5	5	13
Climate and Water	3	9	3	16	12	43
Agricultural Systems and Sustainability	2	4	4	8	7	25
Soil Fertility	5	1	4	9	13	32
Soil Physics and Hydropedology	3	5	1	11	10	30
Total	**24**	**35**	**28**	**70**	**64**	**221**

33 3

* Includes associate professor, senior researcher and senior advisor

** Includes postdoc and temporary assistant professor

Annex 4. Research sections in AGRO

Plant Pathology and Microbiology (PLANMIK, AU Flakkebjerg)

Head of Section: Professor Mette Vestergård Madsen

PLANMIK conducts research in agricultural microbiology, from intimate plant-microbial interactions to biogeochemical processes, plant epidemiology at scales from cell to field crops and population biology of fungal pathogens structures in two groups (Epidemiology and Microbial Ecology).

The Epidemiology group focus on crop diseases, particularly airborne biotrophic pathogens on cereals and grasses. The role of host resistance for prevention and control of plant diseases is a key area. This includes research into host plant responses, pathogen biology, evolution and genetics of virulence and fitness under variable environmental conditions and climate change. We combine various omics technologies, genotypic marker assays and plant response phenotyping, taking advantage of access to a worldwide repository of cereal rust fungi. Via new partnerships, we want to expand our research into new directions ranging from modelling long-range dispersal of plant pathogens involving data science, meteorological modelling and high-performance computing.

The Microbial Ecology group focus on microbiome impacts on plant and soil functional aspects. This focuses on harnessing beneficial interactions between crop plants and soil microbiota. This includes identification of plant genetic and metabolite regulation of root microbiome composition and functioning and mechanisms behind microbiome-aided resilience to pathogens and abiotic stress. The research is conducted within an evolutionary framework, considering domestication processes and management practices important for the evolutionary trajectory of crop-microbiome interactions. Research also includes the contribution of microbiomes and viral communities to biogeochemical cycles, notably soil viral impact on carbon sequestration. The Microbial Ecology group have expertise in a broad suite of (micro)organisms, including viruses, bacteria, archaea, fungi, protists and nematodes spanning the continuum from endophytes, mutualistic plant symbionts and free-living soil microbes to pathogens. High-throughput sequencing (metabarcoding, metagenomics, whole genome sequencing, plant RNA seq), targeted and untargeted metabolomics, high-throughput microbial culturomics and stable isotope probing are core technologies in the group.

PLANMIK has consolidated strong positions within the international plant pathological and plant/soil microbiological academic communities. The section thus hosts the GRRC, a global hub for investigating wheat rusts, established at the request of CIMMYT, ICARDA and the Borlaug Global Rust Initiative. The GRRC team are responsible for the global wheat rust data management platform WheatRustToolbox, a generic and online database-driven information system. Besides, the GRRC holds a worldwide repository of >30,000 stock isolates of rust fungi, a unique resource for targeted phenotyping for rust resistance in plant breeding and research within host-pathogen interactions. The section is currently building capacity within soil microbiology and plant-soil interactions, exemplified by the EU-funded project BarleyMicroBreed, which aims to provide deep mechanistic understanding of links between crop plant genetics, root microbiome recruitment and crop phenotypic plasticity, notably drought resilience.

Crop Health (CROP, AU Flakkebjerg)

Head of Section: Associate Professor René Gislum

The CROP section conducts research across a broad spectrum of crop production topics, aiming to support the green transition and promote economically sustainable agriculture in Denmark and our partner countries. The research focuses on areas such as weed and disease management, seed production and seed technology, digital farming, perennial cropping systems, beneficial plant-microbe interactions for healthy crop production, natural product chemistry and environmental chemistry.

CROP conducts research in laboratories, growth chambers, semi-field settings and both small and large field plot experiments, including field experiments. Whole-field experiments are performed in close collaboration with farmers. Currently, we are involved in two long-term field plot experiments at AU Flakkebjerg: one with various crops and arable cropping systems, combining traditional crop production with specialised crops for biomass, such as miscanthus and willow. The other long-term experiment is on conservation agriculture, where we test different IPM methods. Recently, we established a new long-term strip-cropping experiment to assess innovative IPM methods and incorporate precision farming techniques like image-based weed recognition and spot spraying. In 2023, we launched an agrivoltaics field system to study the effects of solar panels on crop yield, environmental impact and biodiversity. Most experiments involve small plots, and we possess all the necessary field equipment, including robots and unmanned aerial vehicles (UAVs) equipped with various cameras and sensors. Satellite-based imagery is used in projects at the field scale. We develop and validate AI-driven models, using field-captured imagery and our weed library to classify weeds, relate sensor readings with heat maps of insects or to the crops' height, biomass and nitrogen uptake. Seed technology is an integrated part of our work, and we have a state-of-the-art multispectral image system (VideometerLab) to predict physical and chemical parameters in seeds. We have in-house expertise to measure and assess GHG emissions, which is performed in small field plot experiments.

We collaborate closely with a wide network of key stakeholders and partners from academia and the industry. Their active engagement ensures that our research findings are rapidly published and/or translated into practical applications, delivering significant societal value. Academic excellence is a cornerstone of our work. We maintain strong partnerships with national and international universities and consistently publish in high-impact scientific journals.

The section is expanding, and the recent recruitment of tenure track researchers, along with ongoing hiring efforts, will ensure a high scientific standard and support generational renewal in some of our most critical research areas. We place great emphasis on retaining new colleagues by fostering a collaborative, inclusive and supportive working environment. Our commitment to high-quality research, combined with deep expertise, reliability and integrity, underpins our strong relationships with collaborators and stakeholders. We are continually seeking to expand our network within academia and industry and build the best possible consortia for current and future projects.

Crop Genetics and Biotechnology (CGB, AU Flakkebjerg)

Head of Section: Professor Henrik Brinch-Pedersen

The research in the CGB advances sustainable crop production and the plant-based food agenda through research in genetics and biotechnology. The CGB takes an interdisciplinary approach, combining classical plant breeding with modern molecular tools, such as genome editing, DNA markers, bioinformatics and functional genetics. The section has been a pioneer in applying NGTsin crops. The CGB pioneered the application of gene editing in barley (both cisgenesis and gene editing), *Solanum bulbocastanum*, *Euphorbia pulcherrima* and *Campanula portenschlagiana* and is now also applying gene editing techniques in wheat, carrots, rye and potatoes. The section has, with its most recent permanent researcher appointments, strengthened its expertise in bioinformatics, computational genetics and plant genetic resources.

The section boasts a strong infrastructure supporting molecular studies on crops, including classified laboratories, greenhouses, growth chambers, semi-field growth facilities and outdoor growth tunnels, and has conducted open field trials with cisgenic barley. Research focuses on enhancing the genetic potential of crops for yield, quality, disease resistance and climate resilience. Major crops include wild and domesticated wheat, barley, potatoes, carrots and rye, alongside successful projects in ornamentals (*Campanula*, *Euphorbia*, *Lavandula*). The section makes extensive use of plant genetic resources and has a senior researcher specialising in plant genetic resources and seed science.

The CGB is a key player in national and international research collaborations and has extensive partnerships with the industry. The section's goal is to expand further as a stakeholder and project partner. Growing demand, combined with strategic tenure track hires, provides a solid foundation for capacity building. The CGB's research has led to several patents commercialised through Aarhus University's Tech Transfer Office (TTO). This has also spawned two spinouts: PlantCarb and the InnovAction 2024 award-winning HealthyCrop, both actively collaborating with the CGB under competitive grants.

The section is well funded, currently with projects supported by the Independent Research Fund Denmark, the Strategic Research Council, GUDP, Horizon Europe, DFC, Promilleafgiftsfonden and the Novo Nordisk Foundation. CGB researchers hold major PI and Co-PI roles in several large projects.

The CGB is currently in a process with succession of senior scientific staff. By the end of 2025, four tenure track assistant professors will be in place, with more permanent hires planned for the coming years. Successful recruitment of competent permanent scientific staff is essential for the section. The section is experiencing a large increase in the number of policy support tasks, particularly around GMOs and NGT regulations at national and EU levels.

The CGB plays a key role in teaching and supervision, making major contributions to summer courses and the Plant and Food Science programme at the Department of Agroecology and delivering lectures in plant biotechnology at the Department of Molecular Biology and Genetics.

Agricultural Biodiversity (ABD, AU Flakkebjerg, Aarhus)

Head of Section: Senior Researcher Niels Holst

We conduct basic and applied research to advance knowledge on the living conditions for flora and fauna in agricultural landscapes. We study multifunctional land use practices; restoration of habitats for pollinators and other ecosystem service providers; methods for monitoring and assessing agricultural biodiversity; integrated management of insect pests, including chemical and biological control; and honeybee health.

Our staff originate from a diverse academic background, including biology, agronomy, chemistry, computer science, engineering, physics and social science. This allows section members to work in transdisciplinary project teams both within and without the section. The computational platforms (ALMASS, Universal Simulator) developed by us are exceptional and allow analysis of landscapes and complex plant production systems.

We have a well-established collaboration with beekeepers, farmers and the greenhouse industry, providing knowledge-based services (integrated management of honeybee diseases and crop pests) and decision support.

We provide policy support to the Danish ministries and EU authorities concerning agriculture and environment, providing expertise on insecticide and biocide efficacy evaluation and environmental risk assessment. In our research on the social acceptance and uptake of agricultural biodiversity strategies, we emphasise stakeholder engagement and co-development.

We are a newly formed section with two-thirds of the staff coming from another department. This merger of research groups has resulted in a large and diverse network of collaborators outside the department, nationally and across Europe.

Looking forward there is a need to ensure the succession of our senior staff, while preserving the continuity of research, especially concerning our modelling platforms. The basic challenge, however, does not differ from the general challenge facing research in the modern, corporate research environment: We must procure a steady income of external funds to finance our research. Luckily, our focus on biodiversity is well aligned with both the current and future societal interests and needs.

Landscape Research in Sustainable Agricultural Futures (Land-CRAFT, Aarhus)

Head of Section: Professor Klaus Butterbach-Bahl

The Land-CRAFT section constitutes a large part of the Pioneer Center Land-CRAFT, the vision of which is to provide a novel framework that tests and assesses the sustainability of agricultural production, both within Denmark and globally. The Land-CRAFT section covers landscape experimentation, digital landscape analyses, landscape modelling and socio-economy. We are internationally acknowledged for GHG measurements and the use of remote sensing data for landscape dynamics reflecting nutrient flows as input for our biogeochemical modelling. This biogeochemical understanding of landscapes is used in close collaboration with colleagues working on socio-economic aspects, scenarios and stakeholder dialogue.

Based on innovative measuring approaches, implemented at various spatio-temporal scales, Land-CRAFT is developing its modelling platform LandscapeDNDC. This is used to assess management opportunities, such as rewetting, optimised fertilisation and cover crops, to improve the environmental sustainability of agricultural production in Denmark, specifically with regard to GHG and ammonia emissions, C sequestration and N leaching. This is used to analyse measures to increase the sustainability of crop production systems in Denmark. We collaborate with the Danish Technological Institute (DTI), SEGES Innovation and other stakeholders to explore strategies to reduce N_2O and environmental N losses, e.g. in the SmartField project. We use remote sensing to analyse how historical landscape management and use affected the variability of biogeochemical carbon-water-nutrient fluxes, providing essential information for both landscape modelling and socioeconomic analysis. Since the establishment of the Pioneer Center Land-CRAFT in 2022, we have developed capacity within the Land-CRAFT section to address landscape experiments, remote sensing and modelling.

Land-CRAFT has now grown to about 30 members, international early career researchers and supporting staff, which makes supervision with only three senior scientific employees a challenge. Recruitment of senior staff remains a struggle, just as retainment might be a problem in the long run. Overall, the staff development and continuity are challenged by the limited availability of core funding.

We have many national and international collaborators from academia (University of Copenhagen, Danish Technical University, EU networks, collaborators in Germany, the USA, Canada, China, Australia, etc.), industry (SEGES Innovation, RockFlour, AERIALTOOLS Aps., DTI) and vocational schools. We also collaborate heavily with other departments at AU (e.g. BIO, ENVS, ECOS) and sections at AGRO.

We aim at further strengthening our ties to academia and industry, specifically with the focus on remote sensing and sensor development. Furthermore, we have a vision to become a European and global lead on modelling GHG budgets of landscapes by intensifying our collaborations with partners in the USA, Canada, Germany, etc.

Within the Pioneer Center Land-CRAFT, we are developing a stakeholder forum in order to make our scientific results accessible to and applicable for society.

Climate and Water (KLIMA, AU Viborg)

Head of Section: Senior Researcher Jim Rasmussen

The KLIMA section hosts 59 employees (and normally between 3 and 8 guests) of which 16 are senior employees (incl. tenure track), 13 postdocs, 15 PhDs, 4 research assistants, and 11 are AC-TAP and TAP employees. The latter staff group is mainly involved in data and statistics. Thus, the section covers both research and support functions.

The research in KLIMA is characterised by investigations on how cropping systems can be transformed to meet the challenges posed by climate change, environmental impact and loss of biodiversity. This work is done from micro-scale through field experiments to upscaling the impact of novel cropping systems and methods and to understanding the underlying drivers supporting positive transformations.

The research explores new biomass production systems for biorefining, building materials and bioenergy as well as plant-based food from legumes and perennial grain crops related to both productive and marginal agricultural lands. On productive land, we study how to reduce N losses (N_2O and N leaching) from plant residues, how grain and forage legumes can diversify our annual, cover and perennial crops, add C to soil and reduce needs for fertiliser N inputs, how deep-rooted crops affect resilience to diverse climatic conditions, how solar panels can be integrated in a productive land use (agrivoltaics), how biochar can support plant growth and how precision agriculture can support high productivity and low emissions. Linking productive and marginal land, we work on modifying drainage over the year to reduce N losses and study how constructed wetlands best removes nutrients. On marginal land (typically wetlands), we study how paludiculture can be a means to reduce emissions and maintain production, and we investigate GHG emissions when manipulating the water table in C-rich low-lying soils. We also host, together with the GEUS, the national Pesticide Leaching Assessment Programme (PLAP). We are active in several international projects in the EU, China, Asia and Africa.

Modelling is used to simulate crop production, nutrient cycling, soil C fluxes, GHG emissions, in field spatial variation, water use and irrigation and climate change impact and adaptation, using both dynamic process-based (Daisy, LandscapeDNDC, DayCent, APSIM, FarmAC, DSSAT, EvaCrop) and statistical models (NLES). Furthermore, we have initiated work on hybrid-modelling, fusing process-based models with deep learning filtering algorithms to create digital twins. Underlying our research, we employ a range of advanced field experimental infrastructures for biomass production and precision farming. We employ state-of-the-art methods related to (a) in situ and laboratory-based root observations, trait analysis and quantification using mini-rhizotrons, scanners and isotopes (e.g. RootVision), (b) plant-microbe-soil interactions via primary and secondary metabolites (e.g. MS-SIP Interactomics), (c) ecosystem nutrient and GHG fluxes in annual and perennial cropping systems, using eddy-covariance and automatic chambers (e.g. ReWet, ANAEE) and (d) spatial observations and statistics, using hand-held devices or UAVs combined with GIS.

KLIMA also contributes to policy support and education within the above topics. The latter through national BSc, MSc and PhD courses and internationally via capacity building through programmes supported by the Danish International Development Agency (Danida), Erasmus and the Sino-Danish Center.

Agricultural Systems and Sustainability (SYSTEM, AU Viborg)

Head of Section: Professor Marie Trydeman Knudsen

The SYSTEM section carries out research into improving the sustainability of farming and food systems in relation to local and global effects. The focus is on the balance between production efficiency, competitiveness, climate, nature and environmental impact and contribution to the vitality of rural areas.

The primary methodological approach is systems analysis, based on existing data and supplemented by empirical research, and case studies at multiple scales – from the farm and landscape level to the food value chain and national policy level. These systems analyses take various forms, including LCA and farm and landscape scale analyses using various types of models. The section also applies various forms of social science methodologies to analyse the involvement of actors and stakeholders in decision-making processes.

The section is actively engaged in policy support by providing advice related to sustainable land use, nutrient management, climate action and resilient food systems. In the coming years, contributing research-based input to policy and advisory processes – particularly within the framework of the green tripartite agreement – will be a strategic priority. The section's expertise is expected to further policy development and transition to sustainable land management, and this is well aligned with ongoing research projects.

Many projects in the section are developed in collaboration with stakeholders in the agrifood systems. These collaborations ensure that the research is practice oriented, addressing real-world challenges and delivering solutions that are directly applicable. In turn, these partnerships enhance the societal relevance of the research, foster innovation and support the transition toward more sustainable and competitive agricultural and food systems. Several of the section's core research areas are well connected internationally and to major EU projects, where SYSTEM researchers contribute key scientific expertise and frequently assume coordinating roles. Through such involvement, the scientific quality and international reach of the research are significantly enhanced, while strong networks are built with leading European institutions and stakeholders. The researchers in the section are well connected with both national and international research groups as manifested in research collaborations and exchanges.

Soil Fertility (JORNÆR, AU Viborg)

Head of Section: Professor Jørgen Eriksen

The research in JORNÆR targets the interactions between crop growth, soil fertility and the biogeochemistry of nutrients and organic matter turnover in agroecosystems. Key aspects include enhancing use efficiency of nutrients added in plant residues, mineral fertilisers, digestates and animal manure, reduction of GHG emissions and loss of nutrients to the environment and the protection of soil fertility. Improved synchronisation and synlocation of nutrient availability and crop demand is a key research focus in the section. Key scientific questions of the mechanisms and quantification of GHG emissions, phosphorus and nitrogen use efficiency are studied in different agricultural contexts, such as arable/perennial crops, tillage systems and waste management, including digestates and biochar. We apply modelling and conduct experiments at laboratory, plot and field scale, and our research activities span from basic to strategic and applied research with the aim to ensure that agricultural soils remain a sustainable resource supplying nutrients for current and future production of plant biomass.

Over recent years, the section has significantly changed the composition of the scientific staff due to both recruitment and retirement. Since the last evaluation in 2019 the number of professors has increased from two to six and the number of senior researchers/associate professors has gone from seven to none. At the same time, four new tenure track assistant professors have been hired, and the hiring of two more are in process. Also, the group of junior researchers has increased considerably. The recruitment is expected to continue, but at a slower pace, and our focus will be on staff retainment and diversity.

The research output has a high international impact, a standing achieved by extensive collaboration with national and international colleagues. We have strong publication records in high-ranking scientific journals within our research area. Together, we cover crucial aspects of soil fertility, often in collaboration with Danish and international research groups.

The JORNÆR section contributes heavily to Aarhus University's research-based policy support contract with the Danish ministries, especially around nutrient losses and measures to mitigate these. This is evidenced by a very large number of assignments from the ministries. The key scientific questions are focused within relevant subjects, and consultancy reports are with few exceptions based on work published in peer-reviewed international journals.

The section has a significant research collaboration with the industry in the agricultural sector (local and national advisory service, private institutes, local and international dairy, fertiliser and seed companies) and environmental technology (waste management, farm robotics, biogas and pyrolysis). We aim to maintain and strengthen these valuable engagements with the industry to enhance societal impacts.

Soil Physics and Hydropedology (JORD, AU Viborg)

Head of Section: Professor Mogens H. Greve

Research in the JORD section focuses on understanding the critical roles of soil for food security, environmental protection and climate regulation. Soil is the thin, fragile crust of the earth, fundamental to life, yet under constant threat from erosion, compaction, carbon loss and sealing. The research seeks to improve insights into soil's physical, chemical and hydrological processes, supporting sustainable soil management at local, regional, national and European scales.

In society and within the section, there has been an increasing focus on all aspects of soil health. The section develops novel methods for sampling, measuring, modelling and mapping soil properties and soil health indicators, supported by very large soil sample libraries and the associated databases.

In recent years, the section has undergone substantial changes in the composition of its scientific staff, driven by both recruitment and retirements. Since the last evaluation in 2019, the number of professors has risen from one to three, while the number of senior researchers/associate professors now stands at five. In addition, a tenure-track assistant professor has joined the team, with further tenure-track and professor appointments currently in progress. The junior researcher group has also expanded. Recruitment is expected to continue, albeit at a slower pace, with a stronger emphasis on staff retention and diversity.

The section has a strong international position with extensive international collaboration and researchers from the section are coordinating several European Joint Programme (EJP) Soil and Mission Soil projects. We participate actively in international fora, such as the European Soil Partnership and the Global Soil Partnership under FAO and the European Joint Research Centre. Our research has been consistently published in leading scientific journals within our area of expertise.

The section contributes to policy support within its area of expertise. In the past year, there has been a strong focus on delivery of new and updated soil maps, especially new peat maps since these maps are the basis of planning of the future rewetting of the drained peatlands and an integrated part of the Danish tripartite agreement. The section also contributes to policy support within the area of soil health and contributes to the planning of the future soil monitoring.

Outreach in important for the section, and at present the section is leading the world’s largest student-science project activating more than 20,000 Danish elementary school students in the Mass experiment on evaluating soil health in the community where they live.

The section has a strong collaboration with other Danish universities, especially Aalborg University, but also a long history of collaboration with private companies and SEGES Innovation. This collaboration is very important to ensure the relevance of our research.