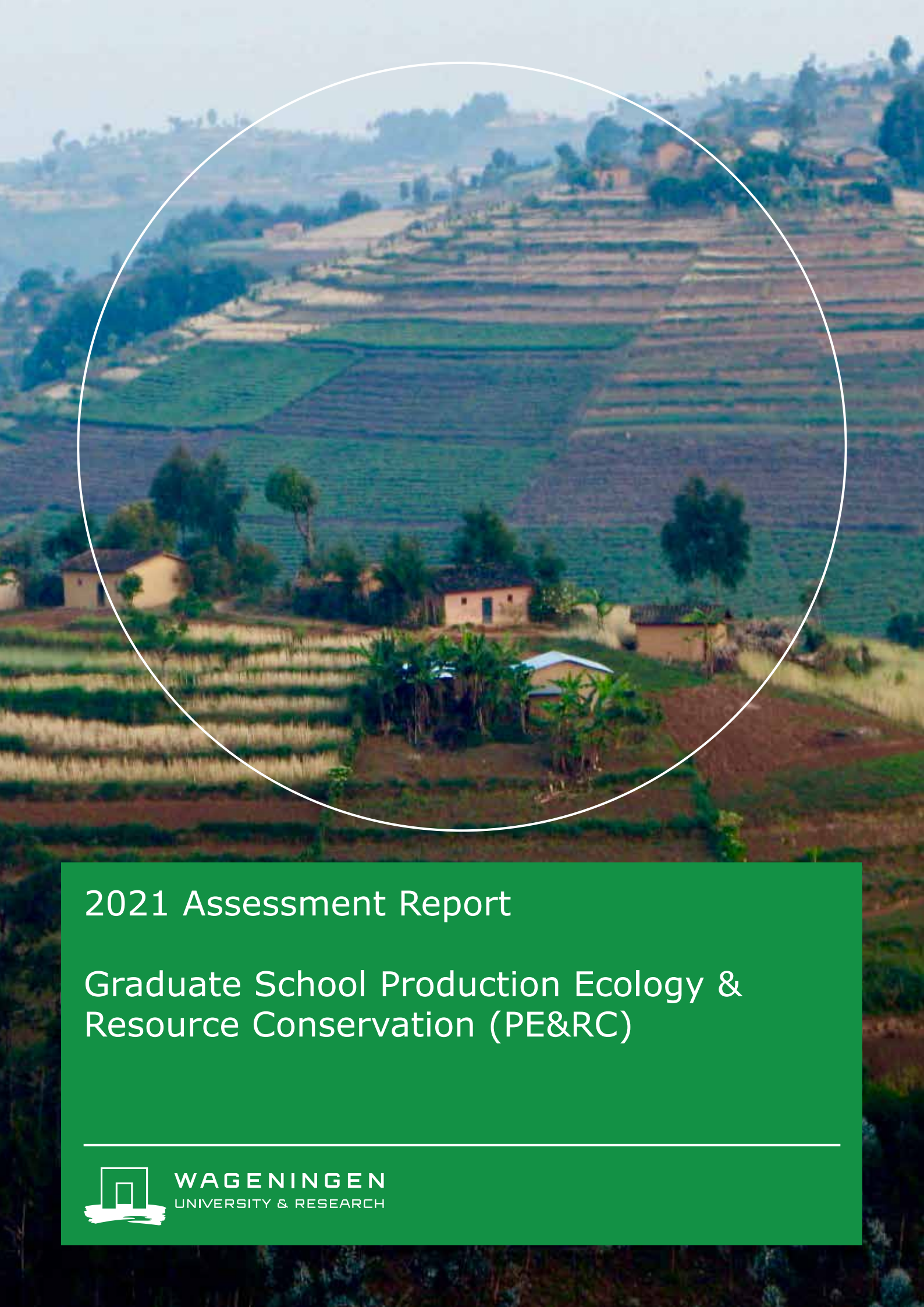

2021 Assessment Report

Graduate School Production Ecology & Resource Conservation (PE&RC)

WAGENINGEN
UNIVERSITY & RESEARCH

2021 Assessment Report

Graduate School Production Ecology & Resource Conservation (PE&RC)

The C.T. De Wit Graduate School PE&RC
PRODUCTION ECOLOGY
& RESOURCE CONSERVATION

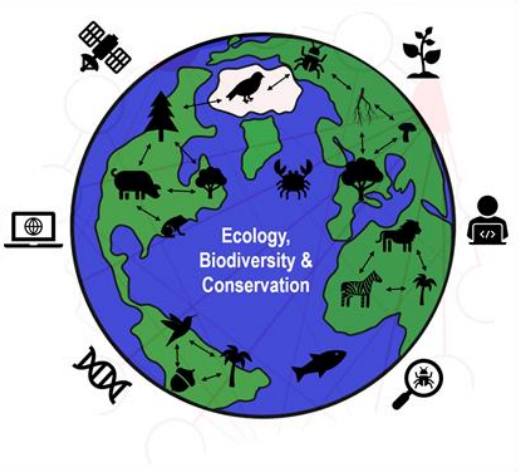

Table of Contents

Preface

The Wageningen Graduate School Production Ecology and Resource Conservation (PE&RC) covers a very broad spectrum of scientific disciplines, while being inspired by the well-defined overall Wageningen University (WU) target of securing long-term sustainable food production.

The organization and embedding of PE&RC is unique, both nationally and internationally, and its activities have an excellent reputation, owing to both its large number of staff involved and for the broad spectrum of PhD training offered.

Since the previous Peer Review in 2015, the PE&RC Graduate School has reorganized itself in four complementary Themes and made considerable progress towards implementing this more integrative conceptualization of its mission, both in terms of research and societal impact.

During the site visit we have encountered sincere dedication to the PE&RC Graduate School by all staff members and PhD students that we met, and we have enormously appreciated their efforts to ensure that we could have a real site visit even though new corona-restrictions became effective as we were arriving.

I gratefully acknowledge the contributions of my eminent colleagues from diverse international institutions, whose dedicated complementary expertise quickly merged into seamless teamwork, facilitated by the highly professional support of our independent secretarial committee member.

Although the Peer Review was demanding, doing this evaluation has been thoroughly enjoyable. It resulted in this report that I am pleased to say represents consensus opinions of the entire Committee.

We hope that this evaluation will help the PE&RC community to continue and renew their excellence in the years ahead, while securing a better understanding of the many pressures that challenge sustainability of human interactions with the semi-natural and agricultural ecosystems that we rely on.

On behalf of all members of the 2021 Peer Review Committee PE&RC.

Prof. Jacobus J. (Koos) Boomsma (Chair)

1 Executive summary

In November 2021 the Wageningen-based Graduate School Production Ecology and Resource Conservation (PE&RC) has been evaluated by an independent international Peer Review Committee.

The review focused on both research and PhD-education of the Graduate School as stipulated in the national Strategy Evaluation Protocol 2021-2027 for publicly funded research organizations in the Netherlands.

Terms of reference were PE&RC's three main objectives: 1. To develop, coordinate and facilitate education and training of PhD-candidates and postdocs; 2. To safeguard, monitor and stimulate the quality and progress of research by staff, postdocs and PhD-candidates; 3. To stimulate and coordinate the development of coherent academic research programs within the mission of PE&RC.

The Committee assessed three general aspects: research quality, societal relevance and viability, and four special aspects: PhD-education and Training, Open Science, Academic Culture and Human Resources Policy.

The evaluation considers both the PE&RC Graduate School as a whole and each of its four Research Themes where the actual research and training of young researchers is taking place.

The Committee based its finding on PE&RC's written self-evaluation report as well as on oral and slide presentations, discussion meetings and facility demonstrations during a three day site visit at the Wageningen University campus.

The evaluation covers the period 2015-2020 (past performance) and the period 2021-2027 (future plans and strategies).

The Peer Review Committee concluded that PE&RC is an outstanding and efficient organization where internationally highly appreciated research takes place and where a top-quality PhD education program is successfully implemented and coordinated by a professional support unit.

PE&RC is positioned at the core of Wageningen University, because it contributes to long-term sustainable food production in an ecosystem-service context, to understanding the ecological and evolutionary forces that shape these ecosystems, to alleviate the health challenges that emanate from biodiversity loss and climate change, and to develop and implement the digitalization and data management solutions for sustainable management of natural resources worldwide.

The Committee met many excellent researchers and a diverse array of highly committed PhD students, who were happy with the facilities, courses and supervision provided by the PE&RC Graduate School. This attests to a very good academic culture with increasing awareness of the need to further diversify staff, commitment to inclusion and personal mentorship, and the facilitation of transparent platforms for staff and PhD students to reflect on structural and practical issues.

The research and training niches of the four recently (2018) established Research Themes are well-conceived and have clear complementary identities and missions. Their research infrastructure, external funding from diverse sources, and working facilities are excellent, and they have implemented extensive societal outreach activities and steadily improving commitments to Open Science.

The Committee concludes that PE&RC has outstanding viability for the coming six years, but also identified some points where further progress can be realized during the coming six year period. The points below summarize the Committee's recommendations, which are further detailed in the chapters of this report.

- Improve monitoring of the reasons for delay in completion of individual PhD programs
  - Across the different categories of PhD students.
  - Across the funding models, so that unproblematic paid 'leaves' for m/paternity and teaching are separated from other types of delay that require focal discussion.
  - Use this information to consider whether mid-term milestones might help to make mutual expectations between students and supervisors more transparent.
- Clarify and disseminate more regularly the requirements for a PhD thesis and revisit them in recurrent internal evaluation.
- Invest in more systematic self-critical reflection on strategic targets, both individually and Theme-wise, but without creating new red tape or compromising individual work-life balance.
- Specify ambitions and targets related to personal and nationality diversity issues while maintaining a broad set of transparent criteria for academic excellence.
- Specify ambitions (per Theme) to improve pursuit and likelihood of success in personal excellence grants from NWO and ERC, and develop human resource policies to sustain them.
- Make these, and other strategic performance indicators compatible with DORA to facilitate transparency in future evaluations.

2 Introduction

2.1 Aim of the assessment

All publicly funded university research in the Netherlands is evaluated at regular intervals in compliance with a national evaluation protocol (currently Strategy Evaluation Protocol; SEP2021-2027), as agreed by the Association of Universities in the Netherlands (VSNU), the Netherlands Organization for Scientific Research (NWO) and the Netherlands Academy of Arts and Sciences (KNAW). The evaluation process, which is applied at the research unit level, consists of an external peer review conducted every six years.

This research quality cycle aims to achieve three generic objectives:
- to assess a research unit in light of its own strategy and aims, including the sufficiency or appropriateness of the aims and strategy;
- to monitor and improve the quality of research conducted by the research unit;
- to contribute to fulfilling the duty of accountability towards government and society.

This assessment concerns the general performance of the Graduate School Production Ecology & Resource Conservation (PE&RC). It focuses on PE&RC's research units in their (inter)national scientific and PhD-training context (retrospective) and identifies ways for further improvement (prospective).

The Terms of Reference for this assessment asked the Review Committee to indicate whether this Graduate School complies with the following three tasks of Wageningen Graduate Schools:
- To coordinate, develop and facilitate doctoral education and training;
- To stimulate and coordinate the development of a coherent research program within the mission of the graduate school;
- To safeguard, monitor and stimulate the quality and progress of research by staff, postdocs and PhD candidates.

2.2 The assessment process

The research assessment as set out in the "Strategy Evaluation Protocol 2021-2027" for public research organisations is based on three central criteria:
- Research quality: the quality of the unit's research over the past six-year period, in light of its own aims and strategy;
- Societal relevance: the societal relevance of the unit's research in terms of impact, public engagement and uptake of the research;
- Viability: the extent to which the research unit's goals for the coming six-year period remain scientifically and societally relevant.

In addition, the following four specific aspects should be taken into account: Open Science, PhD Policy and Training, Academic Culture and Human Resources Policy.

As research within the PE&RC Graduate School takes place at the level of the research units, the assessment criteria are assessed for each research unit, *i.e.* four Research Themes.

Since the last assessment in 2015, PE&RC has reorganized itself by grouping 19 Chair Groups into four higher-level Themes. This reorganization, which in fact started its development in 2014 was based on

natural affinities between Chair groups. In the self-evaluation, these complementarities were documented with an analysis of co-occurring keywords across more than 4000 publications over the years 2015-2020. This organic clustering process towards joint interests has facilitated the formulation of joint mission statements by each of the Themes, which in turn has fostered new collaborations, primarily within Themes but also across. Complementarity is also reflected in staff participation. There is a fairly even distribution of staff normally contributing 60-70% of their time to their own Theme and ca. 5-20% to each of the other Themes. The four Research Themes that have been evaluated are:

- Re-design of Agro-ecosystems
- Ecology, Biodiversity & Conservation
- One Health
- Data and Engineering Sciences

Each of the Research Themes also had the opportunity to formulate one additional question in the assessment committee's Terms of Reference.

At the level of the Graduate School, the assessment Committee was expected to give general findings and recommendations in light of its strategy and three main tasks (doctoral education and training, coherent research program, quality and progress of research). In addition, the Executive Board of Wageningen University has formulated an additional question for the assessment committees of each of the six Wageningen Graduate Schools in its Terms of Reference:

Does the graduate school have a sufficiently proactive innovation process (e.g. exchange of best practice between graduate schools) to continuously improve the quality of its three main tasks?

Since the additional questions had not been addressed first by the School or the Themes themselves, the Committee requested these units to first provide an answer themselves. The Committee would then be able to evaluate whether the respective answer had been answered sufficiently or that it recommended to solve the subject otherwise.

Two weeks before the site visit, the evaluation Committee received the Terms of Reference in which the task and expectations of the Committee was described. Also, a copy of the SEP2021-2027 was provided as a tool supporting this assessment. In addition, the Terms of Reference included a few specific questions for the Committee raised by the board of Wageningen University respectively the leaders of the research themes. According to the SEP2021-2027, the Committee was asked to review the performance of PE&RC in relation to its own strategy and previous targets as well as its international position within the respective research environment.

The Committee was requested to report its findings in line with the three main criteria and the four additional aspects. The findings are reported in a narrative form and followed by recommendations for further improvement. In the text, the considerations of the Committee are clarified, while the conclusions are summarized in an executive summary.

The assessment is based on the following evidence:

- a narrative self-evaluation report describing the aims, strategy and performance of the graduate school and its research units, both for the past six years and for the next six years;
- a site visit focused on discussions with (both temporary and permanent) academic staff.

The site visit took place 14 - 17 November 2021 and consisted of the following elements (Program in Annex 1):

- A plenary introduction to Wageningen University and the PE&RC Graduate School by, respectively, the Rector Magnificus and the Director of PE&RC;
- Individual interview sessions with the Board of PE&RC and Leaders and other representatives of all four Research Themes;

- A meeting and dinner with the PE&RC PhD candidate's council;
- Meetings with the Director General of two involved Wageningen University & Research Science Groups: Plant Sciences Group and Environmental Sciences Group;
- A tour along main research facilities;
- A final plenary debriefing meeting including the PE&RC Board, Director and support staff of PE&RC and the Dean of Research of the Wageningen Graduate Schools. This meeting could be attended online by PE&RC staff as well.

Except from the tour along facilities during which the Review Committee was split into two sub-groups, all meetings were with the plenary Committee.

The Peer Review Committee consisted of five peer members, an expert in the field of PhD education, an independent representative of the Dutch PhD student community and an independent secretary.

The Peer Review Committee consisted of the following persons:
- Prof. Jacobus J. (Koos) Boomsma, Dept. Biology, University of Copenhagen, Denmark (Chair)
- Prof. Ashleigh Griffin, Dept. Zoology, University of Oxford, United Kingdom
- Prof. Bart Nicolai, Dept. Biosystems, KU Leuven, Belgium
- Prof. Mary Scholes, Dept. of Animal, Plant and Environmental Sciences, University of Witwatersrand, South Africa
- Prof. Anne Gobin, Dept. Earth and Environmental Sciences, KU Leuven, Belgium
- Dr. Hans Sonneveld, Director/researcher, Netherlands Centre of Expertise for Doctoral Education, Amsterdam, The Netherlands
- Emma Zuiderveen, Independent PhD candidate, member of Graduate School SENSE, Radboud University, Nijmegen, The Netherlands
- Dr. Chris Mollema, Independent Secretary to the Committee.

All Committee members signed a statement of impartiality and confidentiality declaring that they would judge without bias, personal preference or personal interest, and that their judgement is made without undue influence from persons or parties committed to the institute or programs under review, or from other stakeholders. Members with the most relevant expertise per Theme or subject took the lead in the evaluation process. Bio-sketches of the Committee members are presented in Appendix 2. Their findings and recommendations are described in this report. The final draft of the report was presented to the Director of the Graduate School PE&RC to check for factual errors. The final report was sent to the Board of Wageningen University.

2.3 Quality of the information

The written self-evaluation was the result of a bottom-up process coordinated by a 'writing-group' in each Theme, with some overall supplementary top-down coordination. The Committee understands this approach and its benefits for ensuring broad co-ownership in the evaluation process. However, this way of working precluded that longer institutional memories of permanent staff could place the text in a more long-term development perspective. For example, we missed introduction text in which PE&RC briefly reflected on the Graduate School's recent history and embedding in the overall WU terms of reference. The bottom-up process may also explain why the general 'WUR organization and policies July 2021' and the 'Final Assessment report 2015' were provided as Annex I-I and I-II, but were not addressed in the self-evaluation text. This implied that it was difficult to extract a coherent line of PE&RC performance and development relative to the state of the art at WUR in general, to appreciate the various improvements implemented after the last (2015) assessment report, and to connect recent history to the submitted new strategy plans for the coming six years.

The interviews during the site visit provided the Committee with better insights in PE&RC's position within WU, which was welcome complementary information to what was presented in the self-evaluation. The open-minded discussions that the Committee had with the Theme groups, the PE&RC coordinators, and the WU-research directors came together as a well-informed professional package for evaluating past, present and future developments.

The Committee appreciated the flexibility and efficiency of the PE&RC support unit when additional information (*e.g.* on PhD completion rates and responses to the 2015 evaluation) was requested.

Finally, the Tour along the research facilities as well as the personal presentations by staff and PhD students in their daily work environment was very much appreciated by the Committee members.

3 Structure, organization and mission of PE&RC

3.1 Introduction

Wageningen University and Research involves two separate legal entities: Wageningen University (WU) and Wageningen Research (WR). Both organizations have five overlapping fields of research that are organized in five Science Groups: Plant Sciences, Animal Sciences, Environmental Sciences, Social Sciences and Agrotechnology & Food Sciences. The education takes place at WU according to the Dutch Law for higher education, while WR is a research project organization. WU has organized its research in six Graduate Schools.

The PE&RC graduate school is one of six Graduate Schools that horizontally partition the PhD education at WU forming a matrix superimposed on the five vertical pillars by which the WU and WR are structured and organized. PE&RC also includes focal activities for facilitating career development of postdoctoral fellows. PE&RC is a national PhD Graduate School of which ca. 75% is Wageningen based.

The national Graduate School PE&RC is a collaborative research and PhD training community. Its main aim is to develop, coordinate, and facilitate a world-leading training program for PhD-candidates and post-doctoral fellows within the field delineated by the scientific mission to "*Understand the functioning of natural and managed ecosystems, to improve the quality of life*".

Members of the graduate school are PhD-candidates, postdocs, and scientific staff of Wageningen University, Utrecht University, University of Amsterdam, Vrije Universiteit Amsterdam, Radboud University Nijmegen, Netherlands Institute for Ecology, and Naturalis Biodiversity Centre. PE&RC is coordinated by Wageningen University.

Central focus of the collaboration is the PE&RC PhD program, which is embedded in an academic research environment. The ambition of PE&RC is to be at the international forefront of the scientific field in which it operates, by strengthening a coherent research framework that tackles both fundamental and societally relevant scientific challenges. An international network in which PE&RC operates, allows for a training program for PhD-candidates and post-doctoral fellows.

The scientific mission encompasses research on sustainable agro-production, biodiversity, ecosystem services, one health, the bio-based economy, land dynamics and multifunctional land use at various spatial and temporal scales. The ecosystems studied range from intensive agricultural production systems (*e.g.* greenhouses) to extensive semi-natural systems (*e.g.* agroforests and pastoral systems), to 'natural' systems (*e.g.* wetlands, savannas, (tropical) forests and protected areas). PE&RC covers the fields of bio- and geosciences while it collaborates with socio-economic sciences within Wageningen and beyond.

3.2 Mission and Strategy

PE&RC's three general missions are:
1. To develop, coordinate and facilitate education and training of PhD-candidates and postdocs;
2. To safeguard, monitor and stimulate the quality and progress of research by staff, postdocs and PhD-candidates;
3. To stimulate and coordinate the development of coherent academic research programs within the mission of PE&RC.

Furthermore, PE&RC advises the Executive Board and Science Group directors of Wageningen University *e.g.* on the appointment of new scientific staff. At national level PE&RC primarily focusses on PhD training and education. PE&RC also participates in relevant national networks (*e.g.* Netherlands Ecological Research Network, NERN) and contributes to the national science agenda (NWA) discussions (*e.g.* in the field of biodiversity and agricultural land use).

PE&RC plays a leading role in setting university policies in science issues of general interest such as open science and Postdoc policy.

PE&RC's mission concerning PhD training and education is to enhance, strengthen, and support their PhD Program.

PE&RC's strategy to achieve these goals is based on two main principles:
1. the PhD candidate is in the driver's seat
2. the development of T-shaped skills (A. in-depth scientific knowledge; B. generic skills and competences and C. ability to demonstrate and communicate societal relevance).

PE&RC's research mission is to:
- Understand the complexity of ecosystems and derive unifying concepts at various spatial and temporal scales;
- To assess how these concepts vary between different spatial and temporal scales and different levels of biological organization and complexity;
- Develop theoretical and quantitative approaches in which observation, experimentation and modelling are combined, connected and synthesized across scales;
- Integrate the different required/relevant disciplines and design novel production and land use systems.

PE&RC's strategy to accomplish its mission is by bringing together a broad range of scientific expertise under each of four Research Themes. In this way opportunities have been created for scientific development in sustainable food production, rural land-use and biodiversity. PE&RC views this structure as an opportunity for Wageningen University to take the lead in these research areas.

The mission of each of the four Research Themes is described as follows:
- *Re-design of agroecosystems:* To assess and design sustainable agroecosystems focused on the provision of multiple ecosystem services, resilience capacity and equitable management of natural resources contributing to global food security, resource conservation and societal well-being.
- *Ecology, Biodiversity & Conservation:* To generate insights into ecological processes and interactions and use these to design effective strategies for the protection, restoration and sustainable use of ecosystems and biodiversity.
- *One Health***:** To explore ecological, evolutionary, and molecular processes to improve the health of organisms and the environment they live in.
- *Data and engineering science:* To provide the methods, technologies and tools to solve complex societal problems through integration of novel data acquisition tools, quantitative and qualitative modelling with domain knowledge.

3.3 Management and organization

The national Graduate School PE&RC is a collaborative research and PhD training community. Participating institutes are:

- Wageningen University (WU; coordinator)
- Institute for Biodiversity and Ecosystem Dynamics (IBED) of the University of Amsterdam
- Netherlands Institute of Ecology (NIOO; Royal Netherlands Academy of Arts and Sciences; KNAW)
- Naturalis Biodiversity Center (NBC)
- Department of Ecological Science, Vrije Universiteit Amsterdam (VU)
- Ecology & Biodiversity Group, Utrecht University (UU)
- Institute for Water and Wetland Research (now Radboud Institute for Biological and Environmental Sciences), Radboud University Nijmegen (RUN)

Wageningen University is the prime actor in the National Graduate School with some 70% representation of the individual members.

There is a National Board composed by representatives of all PE&RC institutes and chaired by the chairman of the Board of PE&RC at Wageningen. The PE&RC Board at Wageningen is composed of three senior staff members and a PhD-candidate and will be extended with two mid-career scientists, one scientist with a temporary contract and optionally one non-WU member.

An International Advisory Board (IAB) advises PE&RC on the quality of its activities, particularly regarding the research policy and program and the education program.

The Scientific Director of PE&RC is responsible for the day-to-day management of the Graduate School as well as for the scientific and educational performance of PE&RC. The Director reports to the PE&RC Board and the Executive Board of the Wageningen UR. The Director is supported by an executive secretary, the PhD program coordinators (who jointly conduct the day-to-day management of the Graduate School and represent the Graduate School in formal meetings) and a small administrative office.

PhD-candidates of PE&RC are organized in the PE&RC PhD Council (PPC). Members represent various research fields and categories of PhD-candidates within the graduate school. The main objective of the PE&RC PhD Council is to advise the PE&RC PhD Program coordinators and the PE&RC Board.

4 Findings and recommendations

4.1 Graduate School PE&RC

Chair of the Board: Prof. Ken Giller
Director of PE&RC Graduate School: Prof. Bas Zwaan
Total number of WU research staff (2020): 207 (including 69 postdocs) and 430 PhD candidates

In this section the Committee describes its findings about the overall PE&RC Graduate School and provides recommendations for further improvement in the next six years. Both are presented along the lines of PE&RC's own three general missions (see 3.2). In addition, the Committee gives their opinion on the way in which PE&RC is engaged with specific aspects of its mandate (open science, academic culture and HR-policies) and how the additional question raised by the University Board was addressed.

4.1.1 (Mission 1) *To develop, coordinate and facilitate education and training of PhD-candidates and postdocs*

The PE&RC graduate school spans three different Science Groups within Wageningen University and also encompasses a number of Research Groups at other universities. This report only focusses on the PE&RC graduate school that is part of Wageningen University.

Overall, the Graduate School and doctoral program provide excellent guidance and support for the PhD students. Its program emphasizes independence of the young researchers and provides a wide variety of courses, interim assessments, career preparation activities and supervision, while also offering courses for supervisors. Four further organizational activities stand out as highly positive: 1. The council of PhD candidates, which provides information, assistance and communications to the students and advice to the PE&RC Board, while making sure that the different nationalities and Research Groups are well-represented. 2. The PhD Program *Think Tank*, which is an excellent initiative to advice the national PE&RC Board on education matters, 3. The Buddy system of pairing new and already experienced students, which aims to give new students a smooth start, and 4. The PE&RC weekends to support the students in formulating their aims and providing opportunities for reflection on ongoing work.

The Graduate School provided information about the role of the postdocs in the graduate school and the support they receive, for example through a range of courses and other support options. However, there was no opportunity to exchange ideas with postdocs during the site visit. Recommendations of the 2015 Peer Review Committee appear to have been duly followed. The number of PE&RC postdocs has steadily grown during the past six years, a trend that may well continue. The Committee has been told that postdocs are increasingly being supported in the planning of their further careers within or outside scientific research, although no data about these activities were presented in the self-evaluation report.

The Graduate School is fortunate to have highly dedicated and efficient coordinators. PhD students find it easy to reach out to 'their graduate office' when problems arise. The exit questionnaires that the Committee has seen include mainly very positive evaluations in terms of supervision, promotor engagement, daily supervisor roles, and general support and personal counseling focused on students' future perspectives. While the availability of this information was highly advantageous, the Committee missed similar information on admission of PhD students, their landing in the Research Groups, and the kind of problems that supervisors register. These aspects are now handled mostly at the Chair Group level and might increase the efficiency of the coordination office when information is also available to them.

The PhD students that the Committee met and interviewed generally highly appreciated the supervision, courses and embedment of their training in the PE&RC Themes and Chair Groups. They regarded their PhD period as a good investment in their further career. However, workload and stress were regularly mentioned as a problem in the self-evaluation report, also for PhD candidates. Apart from the completion of a PhD being a generally demanding assignment, stress and workload challenges can become aggravated when student and supervisor interests are only partly aligned because students are primarily interested in pursuing good PhD-degree work while supervisors often think in terms of high-profile publications. Such issues can be constructively resolved, provided they are openly discussed and parties are aware of asymmetries in experience and power between student and supervisor. A higher awareness of these dynamics across all parties involved would likely help to ameliorate problems of this kind.

Given the generally excellent performance of the PE&RC Graduate School, the Committee was surprised that the PhD students on average take at least 5.5 years to graduate (60% finalized their Thesis within 5.5 years), in spite of what appears to be a very careful selection process. The Committee noted that there were no data to break this figure down in specific causes. The Graduate School recognizes the general problems of early attrition and later delays towards completion and acknowledges that the Corona pandemic has intensified these concerns among the students. During site visit conversations, the Committee received some additional information on PhD student's experiences and made the following further observations:

- Many students, and possibly even supervisors, are uncertain about the minimal qualitative and quantitative criteria that a PhD-thesis at WU needs to meet, including the kind of permissible variation around the mean.
- Assuming that these standards are communicated when PhD students start, it might be that they do not sink in very well until later when the writing process starts, and that communication on these criteria needs to be repeated in meetings later on.
- PhD students encounter many 'side'-tasks, *e.g.* extra projects, teaching and supervision, which may be burdens or opportunities depending on whether they are separately paid (thus giving officially recognized extensions of the PhD period) or not. PhD students vary in their appreciation of how easy it is to say no to a supervisor asking such extra commitments.
- There is considerable variation among PhD proposals in level of ambition, depending on whether they are rewrites of external grant proposals or bottom up student initiatives.
- Challenges to the optimal implementation of PhD proposals vary depending on the balance between experimental lab research and fieldwork, and corona restrictions have affected concrete planning and feasibility of these activities unequally.
- While the Corona pandemic has obviously amplified personal and collective challenges of time management, the Committee noticed that PE&RC as graduate school has responded very appropriately by setting up a new course 'PhD in times of crises', by organizing digital and hybrid meetings, and by providing extra funding for potential delays**.**

In light of the above, the Committee supports the wish of the PE&RC Graduate School to initiate an in-depth analysis to gain better understanding of the various reasons for delay and drop-out among PhD students. Such an analysis can indeed specify whether specific categories of PhD candidates could be associated with various degrees of these 'completion challenges', such as: 1. Type of funding for the project, 2. Directly or indirectly associated teaching duties, 3. Research conditions in Wageningen or elsewhere, 4. Additional part-time appointment and leaves of absence due to illness or m/paternity leave. The Committee highly appreciated that some new information could be provided during the site visit. That material suggested that problems of early attrition and delay may apply in particular to sandwich PhDs and guest PhDs, but these impressions need to be verified.

The Committee noted that supervisors are generally highly committed to their students and that there are demonstrable marks of external recognition such as prizes for best PhD-thesis. Supervisor involvement includes making sure as much as possible that students are on track during regular discussions between the students and supervisors. However, the Committee sensed that perhaps not all

opportunities for constructive adjustment between progress evaluations at the end of the second and third year are used maximally efficiently. Delays and possible needs for extension of the PhD trajectory can sometimes already be detected at the end of the second year, at which point remedial action is easier than a year later. The PE&RC discussion groups for PhD manuscripts and proposals, led by PhD candidates, is an excellent initiative and could perhaps be followed up by 1:1 conversations between student and supervisors on the latest developments in student planning of their writing process.

It remained unclear to the Committee how the overall quality of submitted and defended dissertations is monitored at the PE&RC (and WU) level. There is a grading system for PhD theses and the oral defense but no information on how PE&RC theses are graded was available to the Committee, neither in general nor partitioned across Themes and Chair Groups. The Committee realized that implementation of the DORA San Francisco declaration may have discouraged presenting figures, but a narrative on this would have been useful to have.

PE&RC has a clear rule on each PhD-student having at least two supervisors, which the Committee appreciated as highly beneficial for the students. Nonetheless, more information regarding the mean and numerical distribution of the PhD/supervisor ratio would have been helpful, because it seems that some supervisors are very heavily committed. This may often work well, but analysis is needed to clarify whether the PhD/supervisor ratio is correlated with attrition and delay, either directly or indirectly, particularly if further growth in the number of PhD students is expected.

Supervisor training is high on the agenda in PE&RC, which the Committee applauds. It remained unclear, however, whether all critical issues mentioned in the self-evaluation report are in fact covered in the supervisor training program. For example, do all supervisors gain sufficient insight in the selection procedures of PhD candidates, the possibly different supervision requirements across specific categories of PhDs (*e.g.* sandwich and guest PhDs), likely causes of early attrition and delay and instruments to prevent them, organizing and monitoring progress of candidates, and communicating WU criteria of dissertation quality? It can be valuable to regularly ask the supervisors about their experiences with supervision. This could be a valuable addition to the questionnaires that are distributed to PhD students.

Looking at the report of the last Peer Review Committee 2015, the Committee felt that PE&RC has responded extensively and adequately to these earlier recommendations. In some cases, completely new arrangements and rules were established in response to identified deficiencies. For example, strict guidelines for authorships on publications of PhD students have been implemented, although they have not yet been internally evaluated.

4.1.2 (Mission 2) *To safeguard, monitor and stimulate the quality and progress of research by staff, postdocs and PhD-candidates*

There is no doubt that the international Wageningen Graduate School has a worldwide top-reputation that also applies to PE&RC. The Committee acknowledged PE&RC's self-assessment as representing a well-developed, coherent, and internationally recognized PhD program in Bio- and Geo-Sciences, Sustainable Agro-Production, Biodiversity and Ecosystem Services, One Health, and the Bio-based Economy and Multifunctional Land Use. This position of strength in research-training is documented by PE&RC's substantial breadth of disciplines, interdisciplinarity, and field-adjusted citations considerably beyond global average. The Committee was also impressed by the excellent infrastructure and research facilities available to the PE&RC Themes and Chair Groups. Taken together, these achievements imply that PE&RC is very well-positioned to grasp future opportunities and to continue making a positive academic difference related to pressing global issues such as adaptation to climate change, food security and mitigating the consequences of biodiversity loss. Also the engagement in a wide spectrum of international collaborations and fundraising activities, combined with continuing participation in debates on societal relevance issues, will contribute to PE&RC remaining a viable and highly credible research and training unit in the years to come.

Also for this mission, PE&RC received a number of recommendations in the previous (2015) Assessment Report, which have been implemented although continued vigilance is needed to stimulate ambitions for fundamental research that can be funded by competitive excellence grants. The only further challenge that the Committee identified is to find optimal instruments to handle DORA-style evaluations in a consistent manner during the coming six-year period.

4.1.3 (Mission 3) *To stimulate and coordinate the development of coherent academic research programs within the mission of PE&RC*

PE&RC has developed into a Graduate School of optimal critical mass positioned close to the core of the mission of WU as a whole. Its four Themes appear to have grown organically from the bottom upwards, so that complementarity is easily recognizable, for example in the data provided on co-occurrence of keywords of publications. This is a considerable achievement given that the Themes were only implemented in 2018. During conversations with representatives of each Theme, the Committee perceived a clear willingness to further develop, brand, and integrate the Themes to full maturity during the coming 6-year period. The Committee felt that PE&RC has the right academic diversity and critical mass to succeed in making the sum of its joint activities exceed what parts could realize on their own. A smaller Graduate School would lack the diversity to be equally effective and a larger unit would likely surpass the scale at which integration can be synergistic. The present scale will allow PE&RC to remain the prime mover in realizing synergies with its non-WU participants (ca. 25%), and to identify initiatives that could pursue new synergistic initiatives across WU. The Committee appreciated that the current critical mass of PE&RC is likely to be well-suited for handling the continuing tension between realizing societal relevance on one hand and securing sufficient priority for 'blue sky' research, needed to secure deeper and longer-term innovation, on the other hand.

While much has been achieved since the four Themes of PE&RC were established in 2018, following a recommendation in the 2015 report, more can be done to increase the coherence of the joint research programs within Themes in the coming years. The Committee felt that differentiating the 'Ecology and Evolution' niche in two complementary Themes has been a prudent decision because Ecosystem Biology (Ecology and Biodiversity Conservation) and Population Biology (One Health) are globally acknowledged to be distinct, complementary fields. After most efforts during the past few years have been invested in developing coherence within Themes, it would seem natural to also consider collaborations across these two Themes in the coming years, particularly to obtain synergies of scale. For example, both Themes have started to develop programs on tick-borne diseases, which could be integrated better so that coordination roles in international consortia are within reach. For programs at this scale, collaborations with the Data and Engineering Science Theme might also become more obvious. The Theme Re-design of Agroecosystems has more FTEs than any of the other Themes, and has already progressed further in developing synergies of this kind within their own Theme.

4.1.4 Policies and performance on 'specific aspects'

Open Science

The Committee highly appreciates PE&RC for their commitment to outreach and citizen science to complement dissemination of their research via publications in refereed journals. The Committee also noted that PE&RC has progressed significantly towards their longer-term target of publishing 100% open access and that they plan to make further progress from the current 70-80% in the coming years. The Committee likewise appreciated the diverse contributions of PE&RC staff to the NWA, including a variety of key roles in stakeholder recruitment, written contributions via various media and a broad portfolio of research programs entirely or partly financed by public or private partners (varying between 30% to >50% among the themes). A large majority of PE&RC's alumni indeed found professional employment shortly after their graduation with public or private employers, in which they would likely further disseminate their knowledge and skills to society. The Committee noted, however, that the future targets of further expanding PE&RC's open science policies were not very concrete.

Academic culture
Academically, PE&RC has a stimulating academic culture characterized by various types of meetings - open to all staff members and students – often focused on the contributions of specific scientific experts in relevant subfield of research. With respect to general aspects of wellbeing, the Committee appreciates awareness, across the staff and students of PE&RC, of the need to progress further towards a more representative gender balance and of developing more integrated recruitment and retention policies across the international spectrum of academic talent. For the staff and students already active in PE&RC, policies include due attention to various forms of personal and scientific integrity, monitored by councilors and an ombudsman-officer, and facilitation of inclusion via the graduate school's 'buddy' program. The Committee noted with approval that appointment committees (BAC) now always include a Human Resource staff member to specifically supervise diversity issues in recruitment. Likewise, it was acknowledged that PE&RC units have achieved ways to deal with personal challenges - such as bullying, undue workload pressure, and sexual harassment problems - in a professional manner.

Human Resources
In its strategy, PE&RC shows awareness for increasing problems of imbalance between workload and private life, although it is as yet unclear how this problem will be tackled in the years to come. The Committee valued the open exchanges with all PE&RC staff and students on the need to develop such policies across all levels of the organization and of making personal coaches available for individuals that would benefit from help in concrete situations. Although the Committee was told that PE&RC gets many applicants after a vacancy has been announced, its policies of junior talent development and retention of already recognized talent in postdocs and senior staff were not made explicit in the self-evaluation report and during the site visit. These points may need increasing attention because competition for talented personnel of diverse nationalities may in the future constrain PE&RC's recruitment basis, particularly in fields where PE&RC competes directly with industry employers.

4.1.5 Additional question in Terms of Reference

Does the Graduate School have a sufficiently proactive innovation process (e.g. exchange of best practice between Graduate Schools) to continuously improve the quality of its three main tasks?

The three main tasks of the Wageningen Graduate Schools are:
- *To coordinate, develop and facilitate doctoral education and training;*
- *To stimulate and coordinate the development of a coherent research program within the mission of the Graduate School;*
- *To safeguard, monitor and stimulate the quality and progress of research by staff, postdocs and PhD candidates.*

Response PE&RC
The question about the Graduate School is a general one defined at the level of Wageningen University for all Graduate Schools.

With respect to the Graduate School PE&RC the answer to the question related to the first and third bullet is "yes" as shown by our self-evaluation document. The internal innovation process is actively stimulated by input from questionnaires to PhD candidates (both about individual courses, the course program and the role of the Graduate School in general) and input from the PhD candidates via the PE&RC PhD council, input via the PhD program Think Tank, the PE&RC Board, the Scientific Advisory Council and the International Advisory Board. Within Wageningen University there are various organs in which Wageningen University wide issues are discussed, coordinated and implemented such as the Wageningen PhD Council (WPC), the monthly meetings of executive secretaries, the monthly meeting of PhD program coordinators, the monthly meeting of all Graduate Schools (directors, executive secretaries and WPC chaired by the Dean of Research), and the monthly strategic research meeting (directors of Graduate Schools, Dean of Research chaired by the Rector). We also seek innovation in our programs

through inviting international experts to joint courses and share good practice - and by keeping an eye on external developments elsewhere so we can learn from them.

With respect to the second bullet and in particular developments of the themes we have outlined measures at Graduate School level within the Graduate School Strategy section. Both Wageningen Graduate Schools as well as PE&RC have high ambitions with the research units (in this case themes) of which support has to be streamlined at WU level.

Response Committee
Committee members agreed that the PE&RC Graduate School is very well placed to absorb best practice experiences from other graduate schools at WU, from the external members of the school at other Dutch Universities, and from their direct interfaces with other academic institutions in the Netherlands and abroad. As we mentioned above, PE&RC appears to have the optimal critical mass to act and innovate when new opportunities and challenges will appear in the years to come. Integration is a key agenda point, but there is also a healthy awareness among PE&RC staff that every new integration of activities need to have significant added value to be a priority.

4.1.6 Recommendations, numbered according to the sections to which they primarily apply

Within this overall very positive assessment of PE&RC, and well aware that the Themes have only been operational since 2018, the Committee identified some points that would need attention during the coming 6-year period in order not to be perceived as potential weaknesses by 2027. These are:

General point
The self-evaluation report and exchanges during the site visits often focused on optimizing processes rather than output, *i.e.* on means rather than ends. This is understandable given that Themes have only been in existence since 2018. However, the Committee generally recommends that a next self-evaluation report, hopefully after six productive years without major new disturbances, tries to develop an additional focus on milestone-like deliverables. Such focus may invite more critical self-reflection and earlier recognition of new opportunities that should be prioritized at an appropriate scale of collective ambition. In other words and in line with SEP2021-2027, put more emphasis on strategic thinking.

Mission 1 (4.1.1)
1. Consider implementing a yearly assessment questionnaire that explicitly includes questions about the start and progress in writing up manuscripts, so that discussion about structuring this part of the PhD process becomes more explicit and recurrent. To optimize the balance between ambition and workload, one could ask every year whether a student has agreed with her/his supervisors about the level of publication ambition within the general thesis-quality criteria of WU. This questionnaire could also have a supervisor part asking a similar question. Apart from the PE&RC Office, a small committee of supervisors could be involved in evaluating these questionnaires (with due measures to avoid conflicts of interest).
2. Pursue a systematic analysis of early attrition and dropout rates across types of PhD trajectories and PE&RC Themes, to better understand the causes. Such new monitoring routine could produce a structured yet flexible set of rules for organizing a PhD trajectory while differentiating between 'within-payroll/employment contract' and 'outside-payroll/employment contract' reasons for delay in delivering the PhD thesis. The former often work positively (they also include working 4 rather than 5 days a week), while the latter are the real delays on which discussion could then focus. Update analyses could then be considered at, for example, three year intervals.
3. Continue to discuss whether some compensation for corona-related delays may also be needed in the years to come – early delays may be as serious as later delays and cannot automatically be assumed to resolve themselves without increasing workload and stress levels.

4. Further increase awareness of how the entire spectrum of possible asymmetries in personal and cultural backgrounds of students relative to their supervisors can be addressed in ways that alleviate stress and optimize work-life balances as much as possible (see also Academic Culture section below).

Mission 2 (4.1.2)

1. Similar to many other academic environments, PE&RC has been confronted with the DORA San Francisco declaration demanding that individual staff and the PE&RC-collective shall be assessed with a meaningful mix of broad semi-quantitative markers rather than the previous routine of using hard numerical criteria. We recommend further discussion on how to make sure that explicit forward-looking strategies can be developed that remain both merit-based and focused on deliverables when less explicit DORA principles are being used.
2. Consider whether developing a clearer alumni strategy could contribute to the international branding of PE&RC as a global magnet for scientists to work with PE&RC's research programs and contribute to or benefit from PE&RC's training of young researchers.
3. Although PE&RC groups are generally well funded, a more explicit strategy could be developed to try maximizing interest in, and success of, pursuits towards personal excellence grants from NWO and the ERC.

Mission 3 (4.1.3)

1. In the self-evaluation report and during discussions on site, it was repeatedly emphasized that PE&RC in its WU embedding has a unique position relative to other Dutch and international Universities. The Committee fully agrees with this assessment, but would also like to stress that 'uniqueness' always obliges to reach out from privileged positions to coordinate interdisciplinary initiatives with other, complementary unique institutions – for example those with large public health schools. The Committee was pleased to see that such broad European and global initiatives are indeed being taken, but also felt that some Themes could do more in this direction, as will be specified in the Theme-specific evaluations.
2. Continue to further enhance collaborations between the four Themes via joint grants for PhD positions, while keeping in mind to only integrate when synergy potential is obvious.

Specific aspects (4.1.4)

Open Science

1. Consider whether it would be beneficial to formulate a concrete policy for open science milestones that can be achieved in six years' time without increasing the workload or financial burdens of PE&RC staff and students.

Academic culture

1. To continue improving the gender balance among all, but particularly senior staff, from the perspective that higher diversity of staff is likely to have a positive overall effect on research performance. This would need to go beyond the recruitment phase and would, for example, require specific policies on retention of talent after recruitment.
2. This recommendation extends into broader issues of diversity, primarily the objective to move towards a more international permanent staff, and to think about ways to facilitate the employment of spouses and opportunities for international school facilities for the children of newly appointed staff arriving from far away.

Human Resources

1. The Committee sensed that there is general concern about steadily increasing workload from the PhD student level upwards. This is generally an increasing and very hard to solve problem, driven by what seems to be endless opportunities in a globalized academic world. We nonetheless recommend

to start actively considering these challenges and to instill a greater awareness of the need for personal time management based on more explicit evaluation of opportunity costs.

2. Although very good starts have been made, more work is needed to make sure that the organization is aware, at all levels, that diversity is obviously more than gender (age, colour, culture, social-economic background etc.) and that diversity issues extend beyond who is on the PE&RC payroll and also include higher-level structures of power asymmetry that need to be considered.
3. Consider to formalize PE&RC's total activity in postdoc mentoring to an extent that would make it suitable for more structured evaluation in the next 2027 peer review round.

4.2 Evaluation and recommendations research units: four Research Themes

4.2.1 Theme Re-design of Agro-ecosystems

Total research staff (2020): 39.6 FTE and 219 PhD candidates
Chair Groups involved: Crop Physiology (CP), Crop and Weed Ecology (CWE), Soil Biology (SBL), Plant Production Systems (PPS), Horticulture and Product Physiology (HPP), Soil Physics and Land Management (SLM), Farming Systems Ecology (FSE), Plant Breeding (PBR), Soil Geography and Landscape (SGL)

Aims and strategy
The mission of the Theme is to assess and design sustainable agroecosystems focused on the provision of multiple ecosystem services, resilience capacity and equitable management of natural resources contributing to global food security, resource conservation and societal well-being. Therefore, the Theme seeks fundamental understanding of the crop requirements, drivers and mechanisms of agroecosystem functioning, as well as the development of knowledge and tools that contribute to re-designing production systems in multifunctional and dynamic landscapes.

The research strategy of the Theme integrates different spatio-temporal levels of analysis, from crop genotypes, fields and farms to the global level. Its mission is addressed by four research lines: 1. crop performance and breeding, 2. agronomic and technological innovations, 3. ecological processes and diversification, and 4. adaptation and transformation pathways.

Research quality
With four research lines and nine core Chair Groups this Theme is large and covers a lot of ground. The mission statement and vision are clear, and the focus of the research goes from fundamental to applied. The Theme operates unique research infrastructures such as a large plant phenotyping facility, cold storage rooms and interactive mixed reality tools.

Several scientific staff members are key opinion leaders in their field, and the track record of the Theme as a whole is outstanding in terms of quality as documented by indicators such as citation records far beyond average in their field of research. Several staff members have received various awards including an honorary professorship and are well in demand for keynote and plenary lectures at international conferences. They are active in the organisation of many scientific events and in various editorial positions for scientific journals. They also participate in commissions and advisory bodies for the allocation of research money to institutes and decisions of legislative bodies on agricultural issues. The Committee is impressed by the reputation of the Theme, which is internationally clearly at the top of their research area.

The Theme has an important international dimension as reflected by activities such as the global network of lighthouse farms located in 12 countries and the global yield gap atlas that is widely used for decision-making by public and private sectors, NGOs and academia around the world. It has linked its activities to Sustainable Development Goals (SDGs) 1, 2, 13 and 15. The Chair Groups have found each other bottom-up, and currently have a rather loose governance structure – a core group. Strategic decisions such as the continuation of chairs are taken at another hierarchical level, and the decision to hire other scientific staff is at the discretion of the individual chair holders. However, other Chair holders are consulted on whether the position fits within the strategic plan of the Theme during this process. The core group has some resources to support the back office of the Theme and has established their own strategic fund with contributions from different Chair Groups to support integrative scientific innovation within the Theme. This lean governance structure is adequate for reaching the objectives of the Theme.

There is a desire within the Theme to further integrate activities without increasing overhead or introducing a new layer of management. The recent hiring of junior assistant professors offers some opportunities to explore novel research questions of joint interest.

Many research activities of the Theme involve field experiments, which often last longer than the four years that a PhD project would take. At the same time, many journals require at least two years of field experiments for manuscripts to be published. This dilemma is accommodated to some extent by having multiple PhDs covering subsequent experimental periods and by involving Groups from other teams to improve the continuity of long-term experiments, but the Theme recognizes that this issue is hard to solve and that it may contribute to delays and extensions of the time needed to obtain the PhD degree.

The Theme mentions a new focus on Systems Biology in their SWOT analysis, which requires a Big Data /Bioinformatics component. The Theme has therefore established in house competences for managing databases and employs a data steward to help managing research data. The Theme recognizes that they do not have all the required competences for data analysis and therefore also rely on collaborations with other Groups within PE&RC and with the Wageningen Data Competence Centre.

Societal relevance

The research activities of the Theme are highly relevant to current societal concerns about food security, the need to balance food production with improved environmental husbandry, and general sustainability. The Chair Groups collaborate with a broad range of stakeholders and are very active in applying their research results in the Netherlands and around the globe. Examples include the global network of lighthouse farms, the global yield gap atlas, intercropping and strip cropping in Northwest China and the Netherlands, cocoa agroforestry in West Africa, and photosynthesis research. The desire to redesign agriculture systems to become more productive and sustainable underlies many research activities. The societal relevance of the research of the Theme is reflected by the fact that its research and training activities have been referenced in 480 policy documents by more than 35 organisations.

The outreach activities of the Chair Groups participating in this Theme are extensive but also completely decentralised – there is no real strategy because outreach activities are automatically integrated in research projects. Scientific staff members typically identify research results that have potential for outreach and implement such activities together with the communication office. Theme members might want to consider whether more coordination of outreach activities might become desirable in the future.

Sandwich PhD students play an important role in the societal relevance and outreach programs of the Theme. Many alumni supervise new sandwich PhD students abroad, and thus provide continuity to the research programs while securing the societal relevance of the Theme in their home countries. This is essential because research often involves field trials of long duration. Finally, the embedding of the students in strong national research facilities is very important and adds to the probability of success for these students.

Viability

The Theme relies on various funding sources, which has secured a comfortable position of financial stability. Particularly the Theme's success in attracting very large research grants gives confidence in their long-term viability. Ample external funding via a large amount of projects has allowed the Theme to accumulate a financial buffer that Chair Groups use to invest in more risky research projects.

The Theme has initiated working on its future research strategy, and identified four key scientific challenges: 1. Resource-use efficiency, 2. scaling across hierarchical levels from gene to production system and beyond, 3. emergent properties of crop, farm systems and farming systems to support improved land use, and 4. resilience to biotic, abiotic and economic shocks. These new emerging domains enable attracting funding for project applications from different sources. However, in spite of this proactive planning, Theme members indicate that there is a lack of funding possibilities for long-term

research, which may negatively impact research ambitions, although collaboration with other Chair Groups alleviates these challenges. The Committee agrees that these collaborative initiatives deserve to be further explored, also because Theme members recognize that joint proposals will increase the coherence of the Theme. In this context, strengthening collaboration with Social Sciences Groups is also considered.

The Theme offers special support for applicants to highly competitive and financially attractive individual grants such as ERC projects and the NWO Veni, Vidi, Vici program. However, unlike in other universities there does not appear to be a clear strategy to acquire such grants via, for example, incentives to attract external ERC starting grantees.

Open science
The Theme has considerably increased the percentage of open science publications. Data are archived in a data repository, and one of the Chair Groups now has a platform for data and model sharing that can be expanded further to make this output of the Theme publicly available. The Committee appreciates these efforts.

Human resources and academic culture
The Theme scientific staff emphasised their commitment to increasing gender balance and diversity in general by the balanced composition of the delegation that presented the Theme and by the fact that female staff were involved well in the presentation. The Theme has a target of equal participation of women at every level and, while realizing that this can only be implemented in the longer run, special efforts are made to attract women by selection committees. There remains, however, a considerable imbalance in representation of nationalities, particularly from Africa.

The staff is aware of the need to emphasize retention of already appointed women and non-Dutch nationals to make sure they can advance in their career at WUR, including the need to consider job opportunities for partners and aspects of child care. The Committee appreciates these efforts so far and the plans to continue them in the years to come.

With respect to work-life balance, staff members emphasised the support of chair holders when needed. Personal coaches have been successfully involved on several occasions, and both PhD students and staff members have been advised to say 'no' to new requests when necessary for their quality of life. The staff is also very aware of burnout risks and the challenges that the Covid pandemic has brought to PhD students.

The number of research staff has increase by around 10% since 2015, and was rather evenly distributed over the different staff categories.

Question raised by Theme members
We seek advice on how to further our effort in making this Research Theme much more the sum of the component parts.

Answer from Theme members
We describe our plans in the documents submitted, and address this issue as well in our presentation. Given the size of our Research Theme with nine Chair Groups, we do not think it is either wise or desirable that all Groups try and work together in large projects. Rather we take the approach of identifying cross-cutting scientific challenges which we will embed in the research of all of the Chair Groups and in collaborative projects within the Theme, with the expectation that this will lead to new insights and theoretical contributions. Our aim will be to develop cross-cutting synthesis articles that address these scientific challenges, and we have established a core group of mid-career scientists who represent each of the Groups and who will take this forward.

Response Committee
Given the limited WU funding for Theme-level activities, the Committee agrees. All individual Chair Groups are already very successful in their own right, and it does not seem productive to invest resources in large collaborative projects involving all Chair Groups. These typically require a lot of overhead to write and manage while synergistic output may not be sufficient to justify these investments.

Recommendations

1. Given the already high workload of staff and students and the limited financial support (in contrast to the funding of the Chair Groups), keeping Theme-governance minimal without impeding collaboration seems a viable strategy for the coming years.
2. Theme members might consider looking particularly at the interfaces between their different competences and research specializations, because these may well inspire new research that does not require large new investments while easily securing synergy benefits.
3. Consider developing a more explicit outreach strategy if it can be done without increasing overhead.
4. Consider to develop a plan for attracting external ERC grantees and for providing further incentives to ERC and Veni, Vidi, Vici grantees.
5. Continue initiatives to further diversify staff as planned.

4.2.2 Theme Ecology, Biodiversity & Conservation

Total research staff (2020): 24.0 FTE and 141 PhD candidates
Chair Groups involved: Entomology (ENT), Plant Ecology and Nature Conservation (PEN), Wildlife Ecology Group (WEC), Forest Ecology and Management (FEM), Genetics (GEN)

Aims and strategy
The mission of this research Theme is to generate insights into ecological processes and interactions and use these to inform and design effective strategies for the protection, restoration and sustainable management and use of ecosystems and biodiversity. To this end, we deliver fundamental and applied ecological knowledge, at scales ranging from genes to ecosystems.

The strategy has three main research lines: (1) deciphering the mechanisms supporting biodiversity and driving ecosystem functioning, (2) quantifying changes in biodiversity and ecosystem functioning and (3) evaluating effectiveness of conservation and management measures. Within these research lines, empirical studies that make use of observational and experimental data are combined with modelling approaches. The aim is to strengthen the position by increasing the integration within the Research Theme and by making use of the central position in the recently established Wageningen Biodiversity Initiative (WBI) and the WUR-ESG Theme 'Biodiverse-environments'.

Research quality
A clear mission statement sets the tone for the high quality of research results which are produced. The research quality is excellent as is evidenced by the many highly-cited researchers within the Theme as well as many publications in internationally prestigious journals. This excellence is achieved by a group of highly motivated, mostly young and committed researchers and through collaborations with many and well-chosen research entities elsewhere. The collaborators fill the perceived gaps in their portfolio *e.g.*, Entomology supplements the other research Groups. The leadership has provided many funded opportunities for younger researchers to develop their careers. The quality of the specialised infrastructure *e.g.*, Dendrolab, supports the research endeavour. The research is well financed through large projects. Much of the research is fundamental but is strongly linked to applied issues. The researchers contribute to editorships of journals and to reviews and their reputations are acknowledged. The emphasis on "bending the biodiversity loss curve" is well positioned and timely and resonates with the recent IPBES strategy for policy makers, the Biodiversity Conventions and COP26. The research portfolio is large which brings challenges in clustering activities and prioritizing, this can be perceived as a weakness. The three focus areas are well developed with the mechanisms and the loss of biodiversity possibly playing a stronger role than the focus area on conservation and management. The area on conservation and management is a possible weakness in that it needs to work more closely with the Theme on Data and Engineering Science to enhance their large data analytical skills, but it was emphasised by the Group that they already work with the Wageningen Data Competence Center (WDCC) at WU. The committee observed the synergy between this Theme and the One Health Theme.

Societal Relevance
The Theme has a large societal relevance as demonstrated by their commitment to a number of the UN 2030 Sustainable Development Goals (SDGs). There are also several outreach activities that address a wide cross spectrum of society from school children to the research community. This is accomplished through TV, radio, social media and public events. A communication facilitator supports the Group in these activities. Raising awareness on the value of conservation and reducing biodiversity loss is relatively easy to achieve but it is much more complicated to develop tools for qualitative and quantitative assessment of impacts or the research and the outreach activities.

Viability
It was evident throughout the self-evaluation report that the Theme has considered its viability in terms of financial and human capital strengths, and that they feel that they have strategies in place. They have made advances and are on the right track with respect to gender diversity. This has resulted in the

Theme now having more women in senior positions but there is still work to be done. The Theme is doing targeted recruitment, but face considerable competition. Working together with collaborators to grow diversity appears to be a good strategy. The delegation that presented the Theme had a balanced composition and female staff were involved well in the presentation. They are aware of the heavy workload that many researchers are carrying, and this is exacerbated by teaching commitments.

Question raised by Theme members
How can we improve the collaboration within the research unit while still safeguarding the unique features of the individual Chair Groups?

Answer from Theme members
We think that collaboration within our Theme will be successful if (1) research findings and results are shared more frequently and widely among the members of the Theme; (2) initiatives for joint studies/proposals/supervision are created; and (3) supported by the graduate school and higher WUR management. When collaboration within the Research Theme is stimulated and facilitated in this way, away from competition among chairs, we do not think this would put unique features of individual Chair Groups at risk, as unique culture, study objects and methods are retained. Rather, such collaboration will enrich researchers by exploring opportunities beyond the Chair Group, by providing a wider context to studies that complement each other in approaches, systems, and levels of biological organisation, and thus by creating opportunities to generate innovative ideas.

Response Committee
Enhanced collaboration between the Groups should stimulate research but this needs to be done in a way that adds value. Identifying the common features of the various Groups as well as looking at emergent ideas at the boundaries are good ways of integrating the portfolio and prioritizing the research. The retention of passionate young researchers and secure funding is essential to allow for innovative science.

Recommendations
1. Use systems and scenario analyses to help prioritize research.
2. Develop a funding strategy that is two-pronged: 1) funding for large and long-term grants, and 2) smaller and expensive laboratory projects. Clustering research ideas can facilitate large, long-term funding.
3. Develop a review paper by 2023 on advances in the flattening of the biodiversity loss curve.
4. Create an *ad hoc* task team that identifies and produces outlines of possible synthesis papers for the Research Theme so that one synthesis paper is produced each year.
5. Long-term experiments are both an asset and a weakness and need to be monitored for their added value. The identification of common outcomes across the three focus areas will allow for a more integrated research agenda.

4.2.3 Theme One Health

Total research staff (2020): 15.1 FTE and 87 PhD candidates
Chair Groups involved: Nematology (NEM), Entomology (ENT), Virology (VIR), Genetics (GEN), Wildlife Ecology Group (WEC), Crop Physiology (CP), Crop and Weed Ecology (CWE).

Aims and strategy
The mission of the Research Theme One Health at Wageningen University & Research (WUR) is to understand ecological, evolutionary, and molecular processes to improve the health of organisms and the environment they live in. It is composed of Chair Groups with a broad range of expertise. The Theme is still in the early stages of developing a shared focus.

Collaboration, coordination and communication between experts from different fields in a holistic approach are key features of the One Health philosophy. With their mix of applied and fundamental research, the output of the Theme aims to help solve concrete problems in promoting health and controlling disease. The overarching objective is to maximize societal impact by linking research advances to stakeholder priorities.

Research Quality
The Committee was impressed by the quality of the research being carried out by researchers working within this Theme and the pride and enthusiasm staff and students showed in their research. "One Health" is a relatively new concept and the PE&RC network of researchers appears to be well-placed to establish itself as a global centre of excellence. In a global perspective, much of the 'one health' research has focussed on antibiotic resistance evolution in humans, while also zoonotic disease transmission has been pushed to the top of research priorities in universities around the world, not least because of the COVID-19 pandemic.

One of the challenges One Health research in WU faces is the lack of a medical school and depth of expertise in the aspect of human public health. On the other hand, a great opportunity arises from the unique strength of the WU network in the other pillars of the One Health research agenda – food security and eco-system health, and the way these connect to human and animal health. This newly formed research Theme therefore has the potential to help shape the global agenda for One Health research in the future, broadening its scope and adding depth of expertise in the strengths of research across the PE&RC Themes in ecology, biodiversity, food security, and agricultural innovation.

Overall, the Committee felt that this Theme consists of Chair Groups and individual researchers with significant international reputations and excellent publication records. Their focus on ecosystem health and agricultural innovation offers a very good starting position to capitalise on emerging research opportunities complementing possible partners elsewhere. However, the Theme's current focus lacks emphasis on the integrative value of these particular strengths, and has not been sufficiently translated yet into ambitious larger scale initiatives to realize synergies within the Theme and possibly reach out across the PE&RC Themes for obtaining higher critical mass.

Societal relevance
Societal relevance is a major strength of this Theme. Recent outbreaks of zoonotic diseases, the COVID-19 pandemic being only one, have confronted the public with how our health is impacted by the health of animals we depend upon for food. Also increasing awareness of human impact on global warming has pushed environmental stewardship to the top of political agendas around the world. These issues also loom large in the public consciousness so there is a great opportunity to improve public education about the biotic interdependences of the human species. During our conversation with the Theme, research examples were given of animal, plants, microbe, human and environmental health challenges, and interactions with a wide range of stakeholders around the world, including in developing countries, were illustrated. The self-evaluation report provides evidence that researchers are capitalising on this interest, both nationally and internationally, with newspaper and magazine articles, TV interviews and a good web

presence across a wide range of topics for a broad audience, including children and younger adolescents. In addition to these strengths in relevance for the public, the media and national governments, the Theme's coordination of the EU-ITN network *Insect Doctors* is a good example of the international recognition that this Theme already receives and which could provide a stepping-stone towards other such initiatives. However, the current outreach and public education strategy is not very explicit and makes the impression of being mostly reactive rather than proactive.

Viability
The Theme is well-placed to position itself as a global leader in its field, capitalizing on its broad range of expertise. The challenge, as identified in the self-evaluation report, is to maintain focus and cohesion between the different Chair Groups. This problem is aggravated by the fact that staff have time split with other Themes and work in different buildings. Nonetheless, research in this field is well-positioned to exploit a diverse range of funding sources from the more applied side of the spectrum in medical and environmental streams to fundamental research on organismal biology and ecology and evolution. There are also clear opportunities to expand research horizons beyond the local level, and to collaborate more broadly at a national and international level.

A challenge is that the number of scientific staff has remained stable, or declined in the case of postdocs since 2015, while the number of students has gradually increased: in 2020, there were 87 students registered for 6.7 staff FTE, approximately 13 PhD students per FTE of research staff. This is very high. Although there seems limited concern about the capacity of staff to support students, and the students feel well-supported, this trend represents a potential threat to staff well-being and work-load management. It also incurs the risk that staff is too absorbed in supervision to have time to publish and contemplate new initiatives for in depth or collaborative research. The Committee noted that students have identified a need for more appropriate training courses within the One Health Theme, but it should be realized that the work required to design a new course from scratch will further impact on staff workload. There was little evidence of reflection or planning on how to manage expected increases in workload over the next six years – which aspects of academic life need to have priority and where opportunity costs may become too high.

Question raised by Theme members
How we can use the uniqueness of One Health Research Theme at PE&RC to increase the number of opportunities in the future?

Answer from Theme members
The One Health Theme is planning on using its uniqueness (directly linking human and environmental health) to increase its scientific visibility through publications, work with Netherlands Center for One Health and One Health European Joint Project, and societal visibility through outreach, media, and policy documents for the government.

Response Committee
The self-evaluation report and the presentation lacked clarity of exactly where the Theme feels its uniqueness and competitive edge come from. The statement of "uniqueness " used in the presentation recapitulated a definition of One Health in general (with a specific mention of human health), which any One Health Group anywhere in the world could have used. The Committee felt that there was scope to further develop an ambitious strategic plan for how to present One Health research in WU to the wider national and international research community. Such plan should not focus uncritically on creating more opportunities, but prioritize existing and new opportunities so they offer the highest possible added value.

Recommendations

1. Develop a statement of uniqueness that specifically identifies unique strengths, in synergy with the reputation of WU for excellence in ecosystem function and eco-agricultural innovation.
2. Consider to explore more proactively opportunities to develop research programs that can compete for large-scale program funding, *e.g*. developing a consortium on tick-borne disease ecology.
3. Aim to strengthen research links across PE&RC Themes to build on the unique range of expertise in WU that could be made relevant for One Health research.
4. Plan for, and optimize, anticipated increases in workload over the next six years at the collective Theme level. Is the current research staff-PhD student ratio sustainable? Is there capacity among staff (including senior staff) to design new training courses relevant to the Theme?
5. Progress has been made in increasing diversity among new staff hires. To build on this success, the Committee recommends that staff think strategically on how to provide an inclusive working environment and to ensure staff retention.

4.2.4 Theme Data and Engineering Science

Total research staff (2020): 36.8 FTE and 97 PhD candidates
Chair Groups involved: Mathematical and Statistical Methods (MAT), Farm Technology (FTE), Geo-Information Science and Remote Sensing (GRS).

Aims and strategy
The core mission is to provide the research methods, technologies and tools that can be used to solve complex societal problems through integration of novel data acquisition tools, quantitative and qualitative modelling, and domain knowledge in areas such as food security, biodiversity conservation and climate change. The focus is on advancing the methodological state of the art in data science and engineering for agri-environmental applications (including urban environments). This involves areas such as machine learning, machine vision and artificial intelligence, digital twins, autonomous robotics, big data and high resolution remote sensing.

The strategy is to initiate and participate in many national and international research projects of a multidisciplinary nature. The aims are to have an excellent reputation and to be the internationally renowned focal point in (big) data science for agri-environmental applications. The aim is also to extend the modelling capabilities via closer collaboration between the participating Chair Groups within this Theme.

Research quality
The focus is predominantly on sensing, both proximal and remote, and big data analytics. The methods and tools developed are of excellent state-of-the-art quality and usable in many domains, which is reflected in a large cooperative network with other Themes within PE&RC and with other Research Groups across Wageningen University (*e.g.* Soil Geography and Landscape) and worldwide. The Theme has experienced a spectacular growth across the different staff levels, including PhD students. It also maintains a long list of FAIR data sets and software tools in repositories, and has an impressive list of publications. Many of these feature in open access (more than ¾) and/or top journals, and contribute to a field-weighted citation impact well above the global average. The unique position of the Data Science and Engineering Theme within the WU agriculture and environmental science setting offers many opportunities for liaising with other Research Groups to realise joint research and publications. The Theme claims that conference contributions to professional organisations such as those listed by IEEE can be more relevant output deliverables, but the share of these papers is low in comparison to the overall publication output. The Theme appears comfortable with focusing on applied research and appears to have a lower fundamental science ambition at the highest possible level (*e.g.* ERC and NWO Veni, Vidi, Vici). In the Theme's view there is no tension or competition between these types of research, because concrete projects always perform applied science with a fundamental basis. The Committee notes, however, that due priority for fundamental innovation is necessary to ensure that research can remain at the international cutting edge.

Societal relevance
Data mining and big data analytics are in high societal and scientific demand from different domains such as food security, biodiversity conservation and climate change. The Theme is composed of different (former) research lines, which are connected through methodology and therefore span a large set of thematic topics and applications ranging from the field to global scale. The Theme manages to focus its research on global challenges of major public concern, such as de-forestation and food security. Many of the research topics and products are realised through co-creation with stakeholders, and benefit from an overall high throughput towards the end-user. The Theme's research output is increasingly valorised in terms of products and services, which in turn triggers questions on efforts and support beyond contract research in terms of patents, licences and spin-off creation. The Theme has an overall excellent understanding of the societal implications of using certain data sources, which is fostered by cooperation across a large number of sectors and organisations, *i.e.* across industry, government and non-governmental organisations.

Viability
The combination of a fundamental understanding of data science and practical applications exemplified by high throughput phenotyping and digital twins, puts the Theme in a pivotal position for many more applications and developments. The large portfolio of predominantly contract research, ample opportunities for research valorisation, and strong (inter)national cooperation across different disciplines has already resulted in spectacular growth, and comes with a strong competition from the data industry which in the long term may pose a danger to keeping highly skilled staff. Another possible threat is the focus on data-driven modelling with less attention to process-based biophysical modelling. Competition with small AI companies that are now rapidly emerging will likely impose fierce competition in the near future. In addition, the Committee had some concerns that (part of) the Theme might be forced into a service role rather than prioritizing their own (methodological) research focus. A gender balance and diversity policy seems remarkably absent in the Theme, *e.g.* senior staff are male only. A broad range of training courses are on offer, which includes open education through MOOCs.

Question raised by Theme members
Knowing that the governance structure and funding streams at WU are not supporting the Theme structure (and its collaboration), how can we optimise collaboration at the Theme level and maximise our impact and viability?

Answer from Theme members
The core mission of our Theme is to provide the research methods, technologies and tools to solve complex societal problems through integration of novel data acquisition tools, quantitative and qualitative modelling with domain knowledge. In the self-evaluation document (V) of Research Theme "Data and engineering science" we have identified several major current and future research activities related to this mission. The identification is based on the expertise we have on research methods, technologies and tools for acquiring and analysing all kinds of heterogeneous data in the Wageningen domains.

By trying to link these collaborative activities to, *e.g.*, the major investment themes of Wageningen University or to the 4TU federation at national level, we expect to obtain funding. The major advantage of working together is that a whole pipeline can be developed and there are plenty of applications for which such a pipeline is ideal. Taking plant phenotyping as an example, the GRS Group has lots of expertise with data acquisition by means of drones and analysing such data, whereas FTE has experience in developing field robotics. An interesting question could be: Can the robots be directed by information from the drones in future? Biometris is the key partner for the modelling and the statistical analysis. Finally, we will try to create more impact by good visualization tools, such as virtual reality, to support the distribution of the outcomes as part of our open science strategy.

Knowledge and experience in the various (Wageningen) application fields is present in each of the Groups of our Theme, which is very important to bridge between real-life problems, their context and data analysis and modelling. There will be several cases where a collaboration between the Groups within our Theme is having an obvious added value, making the Theme valuable. However, there are and will be plenty of cases where the collaboration of one of the Groups in our Theme occurs with other Chair Groups (inside and outside of PE&RC) and with other Groups outside of Wageningen, both nationally and internationally. The Theme level should not act as a straitjacket.

Finally, the design work and approach, as also envisaged in the new Professional Doctorate in Engineering (PDEng) program that will start this year, could contribute to the further collaboration between the Groups.

Response Committee
The answer to the ToR question is well formulated and demonstrates awareness of the many opportunities to strengthen collaboration between the different Chair Groups to create thematic synergies. Although the Theme expects to obtain funding from WU, there appears to be no pro-active strategy to realise this goal.

Recommendations
The Theme has an excellent innovation process, which matches current societal demands to such degree that funding through predominantly contract research is abundantly available. However, this current situation may not last since competition for assignments and staff with industry is increasing. The recommendations from the panel for the Theme are therefore to:

1. Formulate a sound and solid research strategy and action plan to maintain and strengthen the Theme's pivotal position during the coming six years and beyond.
2. Explore thematic synergies between data-driven modelling and process-based biophysical modelling.
3. Further explore synergies between the different Chair Groups and PI-level units, prioritise research rather than application domains, and avoid fragmentation of the Theme's coherence that may result from a too exclusive focus on contract research (and profit making).
4. Ensure gender and diversity balance within the different sub-Groups and across the Theme, preferably across the different staff categories.
5. Strategically address the challenge of integrating a new cohort of 2-year technically oriented professional doctorate students, taking into account that continuing growth and increasing turnover of staff may leave the Theme with fewer experienced staff in the years to come.

Annex 1 Program Site visit

Meeting locations during the site visit:

- Forum Building Wageningen University
- Hotel: WICC, Lawickse Allee 9, 6701 AN Wageningen

Sunday November 14 (WICC)	
Arrival	
16.00	Welcome, introduction to the peer review, WUR and PE&RC (PE&RC Board, PE&RC office) – Room Talent Street 10
17.00	Drinks (with PE&RC Board, PE&RC office)
17.30-18.30	Preparatory meeting committee – Room Talent Street 10
18.30-20.00	Dinner committee WICC
Monday November 15 (site visit: Forum Building V0031)	
8.00	Transfer WICC – Forum Building (taxi)
8.30-9.15	Welcome and introduction by Arthur Mol, Rector Wageningen University
9.15-10.00	Graduate school tasks and responsibilities (PE&RC Board and PE&RC office)
10.00-10.30	Break
10.30-11.30	PhD program and postdoc/staff support (PE&RC Board and PE&RC office)
11.30-12.30	Evaluation PE&RC meeting + Preparation theme sessions (committee)
12.30-13.30	Lunch Grand Café Forum (committee)
13.30-14.45	Research theme Data and engineering science Presentation (incl. cases 30 minutes) followed by interview
14.45-15.15	Research theme reflection (committee)
15.15-15.30	Break
15.30-16.30	Meeting with PhD candidates
16.30-17.45	Internal meeting committee
17.45	Transfer Forum Building – WICC (taxi)
18.00-20.00	Buffet with PhD candidates (Kings Garden, Stadsbrink 1M, Wageningen)
Tuesday November 16 (site visit: Forum Building V0031)	
8.15	Transfer WICC – Forum Building (taxi)
8.45-10.00	Research theme Ecology, biodiversity & conservation Presentation (incl. cases 30 minutes) followed by interview
10.00-11.00	Break and research theme reflection (committee)
11.00-12.15	Research theme Re-design of agroecosystems Presentation (incl. cases 30 minutes) followed by interview
12.15-12.45	Research theme reflection (committee)
12.45-13.45	Lunch Grand Café Forum (committee)
13.45-15.00	Research theme One Health Presentation (incl. cases 30 minutes) followed by interview
15.00-15.45	Break and research theme reflection (committee)
15.45-17.15	Campus program (facilities and experiments, in 2 groups of 4 panel members) Group 1: One Health – Ecology, Biodiversity & Conservation Group 2: Data and Engineering Science – Re-design of agroecosystems
17.15-18.15	Internal meeting committee
18.15	Transfer Forum Building – WICC (taxi)
18.30-20.00	Dinner committee WICC

Wednesday November 17 (site visit: Forum Building V0031)	
8.30	Transfer WICC – Forum Building (taxi)
9.00-12.00	Meeting committee
12.00-13.00	Lunch Grand Café Forum (committee)
13.00-13.30	Meeting with directors Science Groups
13.30-14.00	Meeting with office/Board PE&RC
14.00-16.00	Writing report
16.00-17.30	Presentation preliminary findings committee for all PE&RC staff members, Board and Dean of Research (Room C0226 Forum)
17.30	Transfer Forum Building – WICC (taxi)
	Dinner committee (to be determined)

Meetings with representatives from the Themes covered all Research Groups involved in the Theme.

Annex 2 Bio-sketches of the Peer Review Committee members

Prof. Jacobus J. (Koos) Boomsma (chair)
https://www1.bio.ku.dk/english/staff/?pure=en/persons/186303
jjboomsma@bio.ku.dk
Koos received his PhD from the Vrije Universiteit in Amsterdam (1982) and had postdoctoral assignments in Utrecht, Oxford and Cornell, funded by a C & C Huygens stipend from NWO. He was an Associate Professor in Aarhus and moved to Copenhagen in 1999 to become Professor of Evolutionary Biology. Starting out as a community ecologist, he soon became primarily interested in unravelling the fundamental principles of animal social evolution, both by extending existing evolutionary theory and by spearheading a number of empirical research programs. These focused primarily on ants and other social insects, aiming to understand why natural cooperation can be stable in spite of potential conflicts at multiple levels of biological organization. His research is interdisciplinary and includes field studies (mostly in Panama), experimental work and genetic, genomic and proteomic analyses. After coordinating two EU-Training Networks he became director of the Copenhagen Centre for Social Evolution, which hosted many individual EU-Marie Sklodowska-Curie fellows. He has been President of the International Union for the Study of Social Insects (IUSSI) and has served on the publication board of the Nordic Society Oikos and on a broad spectrum of editorial boards for specific journals. He has been a member of assessment panels for the ERC (twice as Chair), the Marie Skłodowska-Curie Actions, the Volkswagen Foundation, the Dutch Spinoza Prize and the Dutch NWO-KNAW Research Institutes.

Prof. Ashleigh Griffin
https://www.zoo.ox.ac.uk/people/professor-ashleigh-griffin#/
ashleigh.griffin@zoo.ox.ac.uk
Ashleigh has a BSc(Hons) in Zoology from Edinburgh University, UK, where she also completed her PhD research on the social behaviour of meerkats in 1998. Based in the Department of Zoology at Oxford University since 2009, her current projects fall into three main categories: (1) The application of social evolution theory to understand clinical problems of bacterial infection. (2) The use of meta-analysis to test predictions of social evolution theory in patterns across species, primarily cooperatively breeding birds. and (3) development of planarian flatworms as a model system for understanding the evolution of complex multicellularity. For this work she has received several awards including Royal Society Research fellowships, the Scientific Medal of the Royal Zoological Society of London and a L'Oreal For Women in Science Award, and an ERC Consolidator award. She has a special interest in student welfare, equality and diversity in science and academia: she is the New College Tutor for Graduates; chair of the Equality and Diversity committee for the Departments of Plant Sciences and Zoology where she has been responsible for producing the gender quality action plan (Athen Swan award scheme) and the first ever racial equality action plan; and coordinates undergraduate admissions for biological sciences in Oxford where she is responsible for delivering equality of access. She currently serves on the ERC Starter Grant panel.

Prof. Bart Nicolaï
https://www.kuleuven.be/wieiswie/nl/person/00014537
bart.nicolai@kuleuven.be
Bart has an MSc in Agricultural Engineering (Ghent University, Belgium) and Applied Mathematics (University of Leuven, Belgium). He obtained a PhD in Applied Biological Sciences in 1994 at the University of Leuven (Belgium) where he now is a full professor and leads the Postharvest Research Group. He is also director of the Flanders Centre of Postharvest Technology, a public-private partnership which was established by the University of Leuven and the Association of Belgian Horticultural Co-operatives in 1997, and co-founder of the Optiflux spinoff company. He was chair of the Biosystems Department at KU Leuven from 2016 to 2021. His main research area is postharvest biology and technology, with a focus on gas transport and metabolic reprogramming during hypoxic storage of fruit and vegetables. His groups also develops novel X-ray computed tomography methods for visualising the multiscale structure of fruit and vegetables, and fast techniques to analyse their flavour. He has been on the editorial board of several scientific journals and was editor-in-chief of the journal Postharvest Biology and Technology from 2016 to 2020.

Prof. Mary Scholes
https://theconversation.com/profiles/mary-scholes-1116199
https://scholar.google.co.za/citations?user=qNlkIIMAAAAJ&hl=en
Mary.Scholes@wits.ac.za
Mary, a graduate of the University of the Witwatersrand, is currently a full professor in the School of Animal, Plant and Environmental Sciences. Her research activities focus on systems analysis in a variety of disciplines including, soil fertility, food security and biogeochemistry in savannas, plantation forests and croplands. She is currently actively involved in monitoring water pollution, food security, forestry and climate change and policy implementation in South Africa. Her publication record is extensive; she has mentored over 85 postgraduate students and she teaches at postgraduate level and undergraduate levels at the University. She has been awarded the Vice-Chancellors Teaching, Research and Academic Citizen Awards. She is a fellow of the Royal Society of South Africa, the South African Academy of Science, the World Academy of Sciences and the African Academy of Sciences. She is the recipient of several national and international awards including being elected as a foreign member of the Royal Swedish Academy of Agriculture and Forestry. She has served on Senate at Wits for over 25 years and has served on Council for three terms.

Prof. Anne Gobin
anne.gobin@kuleuven.be
Anne is professor in the Faculty of Bioscience Engineering (Division of Earth and Environmental Sciences, KU Leuven University), and R&D manager at the Remote Sensing Unit of the privatised Flemish Institute for Technological Research (VITO NV). Anne is editor of Climate Research; and guest editor of Remote Sensing and Natural Hazards & Earth Systems Sciences. Her research domain centres around "agricultural soil, water and land management in a changing climate" using remote sensing, geomatics, process-based crop modelling and machine learning techniques to improve knowledge and develop solutions to alleviate climate impacts on the agri-environment at the field to catchment and regional scale. Anne was seconded to the University of Peradeniya Sri Lanka, the Rice Research Institute Thailand, the University of Nigeria Nsukka, the University of Copenhagen and the European Environment Agency. She has assumed advisory roles and consultancies for international organisations (*e.g.* FAO, UNCCD, OECD, JPI Climate, EC-DGs); the private sector (*e.g.* insurances, seed and agri-chemical companies, (weather)data companies) and Think Tanks (*e.g.* KVAB, Farmers' Union). Her current project portfolio includes applied national and international research projects such as EC grants, and fosters cooperation with companies and research organisations across Europe, China and Vietnam.

Dr. J.F.M. (Hans) Sonneveld
Sonneveld.j.f.m@gmail.com
Hans has been a specialist in the field of doctoral studies for 35 years. During his Graduate School managing directorship (University of Amsterdam), he wrote his dissertation: PhD supervisors, PhD candidates and the Academic selection - The collectivization of the Dutch PhD system. He advised faculties on their doctoral policy and provided training for PhD supervisors at home and abroad (Belgium, Germany, Switzerland, Croatia). Research remained a core activity. He conducted PhD surveys, studied rejected dissertations, and very delayed PhD projects, investigated the quality of the Dutch Graduate Schools, and did research on the quality of supervision at various universities. Together with Heinze Oost he founded the Netherlands Centre of Expertise for Doctoral Education in 2006 (www.phdcentre.eu). He is currently finalizing a handbook for PhD supervisors, MA/MPhil students, early PhD candidates and Graduate Schools: The Art of Writing a PhD Proposal - A Handbook to Facilitate the Transition to PhD Candidacy. The book is based on five years of supporting and teaching Research Master students when writing a PhD proposal and will be published by Open University Press in 2022. Together with the fellow board members of the Netherlands Centre of Expertise for Doctoral Education, he published October 2021 Good Practice Principles for Graduate Schools in the Netherlands.

Independent PhD candidate:
Emma Zuiderveen MSc
emma.zuiderveen@ru.nl
Emma is a PhD student affiliated with both the Radboud University and the Joint Research Center (JRC), the European Commission's science hub in Ispra, Italy. She is part of the environmental science group of the Radboud Institute for Biological and Environmental Sciences (RIBES) and the Bioeconomy & Land Resource Unit at the JRC. She holds a MSc in chemistry following the track 'Energy for Science and Sustainability' and a BSc in Chemistry and Liberal Arts & Sciences. Her research focusses on a sustainable bio-economy and the environmental footprints of new bio-based materials for the chemical industry. To determine the environmental impact of emerging bio-based chemicals, her research is based on prospective life cycle assessment (LCA), considering the entire value chain of a product, from feedstock to manufacturing, use and end of life. Before starting the PhD project, she was involved in movements addressing different societal issues, such as being a board member of FNV Vrouw (Dutch National Union for Women), core-member of the Comité 21 Maart (anti-racism coalition) and co-founder of the platform Groenhuiswerk (groenhuiswerk.nl).

Executive Secretary to Peer Review Committee PE&RC:
Dr. Chris Mollema
chris.mollema@ru.nl
Since 2006, Chris is senior advisor research at the central staff department 'Research & Impact Strategy' at Radboud University, Nijmegen. He had a similar position at the department 'Research Strategy' at Wageningen University & Research (1998-2006). In these jobs he is/was prominently involved in research quality, assessments of research units and future planning. He served at several international research evaluation committees as secretary or member, and held an invited lecture during the seminar 'Research Evaluation & Assessing Research Quality' at the European Academy, Berlin 2016. After his MSc (Biology) at Utrecht University and PhD at Leiden University he became senior researcher 'Breeding for Resistance to Insect Pests' at Wageningen University & Research (1987-1998). In this period he established a team of PhD students, postdocs, guest researchers and research assistants working on durable resistance to herbivorous insects in several crops. He acquired a personal grant from the EU to work abroad, so during 1994 he was visiting professor at Warwick University, UK. He is an elected Fellow of the Royal Entomological Society (UK) and a previous editor of the international journal *Euphytica* (1988-1998). From 2001-2005 he was member of the Committee on Agriculture, Food and Biotechnology of the European Science Foundation's program COST to select and supervize European collaborative research programs. He was also member of several committees of the Dutch Ministry of Agriculture (*e.g.* on Genebanks) and many selection and supervisory committees of PhD projects financed by the national Government.

Annex 3 Quantitative data on the research unit's composition and funding

Number of WU staff, postdocs and PhD-candidates over 2015-2020 within PE&RC

	2015	2016	2017	2018	2019	2020
Scientific staff	123	122	124	129	141	139
Post-docs	52	56	57	58	63	69
Subtotal	**175**	**178**	**181**	**187**	**204**	**207**
PhD-candidates						
- Employed	130	136	130	135	146	167
- Contract	143	155	160	169	179	193
- External	75	78	71	75	72	69
Subtotal	**348**	**369**	**361**	**379**	**397**	**430**
Total	**523**	**547**	**543**	**566**	**601**	**637**

Research staff of Theme Re-design of agroecosystems

	2015		2016		2017		2018		2019		2020	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Scientific staff [1]	52	19.0	53	18.3	55	18.9	55	18.9	61	21.4	60	21.3
Post-docs [2]	23	17.0	26	19.3	25	20.2	20	15.3	19	15.6	24	18.3
PhD candidates[3]												
- Employed	62	-	68	-	70	-	72	-	69	-	69	-
- Contract	96	-	102	-	101	-	102	-	107	-	116	-
- External	37	-	37	-	35	-	38	-	35	-	34	-
Total	**270**	**35.9**	**286**	**37.6**	**287**	**39.1**	**288**	**34.2**	**292**	**37.0**	**303**	**39.6**
Lab Technicians	13	-	15	-	15	-	15	-	19	-	21	-
Visiting fellows	6	-	6	-	9	-	8	-	12	-	3	-
Total staff	**289**	**35.9**	**307**	**37.6**	**311**	**39.1**	**310**	**34.2**	**322**	**37.0**	**327**	**39.6**

#: Total number of staff members

FTE: Research Capacity in Full Time Equivalents (not for laboratory technicians)

Standards for Research Capacity (in case of part time appointment adjustment is needed):

[1]Professor, Assistant Professor and Associated Professor: Research Capacity = 40% of the appointment

[2]Post-doc: Research Capacity amounts to 90% of the appointment (if not otherwise specified)

[3]PhD candidates: number of PhD candidates (both internal and external)

Funding of Theme Re-design of agroecosystems

	2015		2016		2017		2018		2019		2020		Average	
Funding:							FTE/%							
Direct funding (1)	45.7	38%	41.7	34%	33.2	29%	29.4	26%	31.9	27%	32.8	26%	35.8	30%
Research grants (2)	14.1	12%	22.8	8%	22.7	20%	21.8	19%	23.9	20%	19.2	15%	20.8	17%
Contractresearch(3)	59.7	50%	59.9	48%	60.5	52%	62.3	55%	63.6	53%	72.3	58%	63.1	53%
Total funding	**119.4**		**124.4**		**116.4**		**113.5**		**119.5**		**124.3**		**119.6**	

Note 1: Direct funding by the University

Note 2: Research grants obtained in national and international scientific competition (e.g. grants from NWO, KNAW)

Note 3: Research contracts for specific research projects obtained from external organisations,such as industry, governmental ministries, European Commission, charity organisations

PhD candidate: Research capacity amounts to 75% of the appointment/fellowship (all categories except external)

Research staff of Theme Ecology, biodiversity & conservation

	2015		2016		2017		2018		2019		2020	
	#	**FTE**	**#**	**FTE**	**#**	**FTE**	**#**	**FTE**	**#**	**FTE**	**#**	**FTE**
Scientific staff [1]	42	13.7	40	13.3	39	13.9	40	14.2	40	13.5	38	12.8
Post-docs [2]	16	13.8	17	14.2	18	14.8	18	15.6	19	15.7	15	11.2
PhD candidates[3]												
- Employed	48	-	47	-	41	-	42	-	47	-	63	-
- Contract	34	-	41	-	41	-	42	-	46	-	57	-
- External	14	-	18	-	18	-	20	-	20	-	21	-
Total	**155**	**27.5**	**163**	**27.5**	**157**	**28.7**	**162**	**29.8**	**172**	**29.2**	**194**	**24.0**
Lab Technicians	2	-	2	-	2	-	3	-	4	-	2	-
Visiting fellows	0	-	0	-	3	-	0	-	1	-	0	-
Total staff	**157**	**27.5**	**165**	**27.5**	**162**	**28.7**	**166**	**29.8**	**176**	**29.2**	**195**	**24.0**

#: Total number of staff members

FTE: Research Capacity in Full Time Equivalents (not for laboratory technicians)

Standards for Research Capacity (in case of part time appointment adjustment is needed):

[1]Professor, Assistant Professor and Associated Professor: Research Capacity = 40% of the appointment

[2]Post-doc: Research Capacity amounts to 90% of the appointment (if not otherwise specified)

[3]PhD candidates: number of PhD candidates (both internal and external)

Funding of Theme Ecology, biodiversity & conservation

	2015		2016		2017		2018		2019		2020		Average	
Funding:							**FTE/%**							
Direct funding (1)	24.0	35%	26.4	36%	28.9	39%	31.3	39%	32.6	38%	33.2	35%	29.4	37%
Research grants (2)	17.8	26%	23.4	32%	23.7	32%	25.6	32%	29.2	34%	31.8	34%	25.2	32%
Contractresearch(3)	27.6	40%	22.5	31%	22.4	30%	23.8	30%	23.4	27%	28.8	31%	24.8	31%
Total funding	**69.3**		**72.3**		**75.0**		**80.8**		**85.2**		**93.8**		**79.4**	

Note 1: Direct funding by the University

Note 2: Research grants obtained in national and international scientific competition (e.g. grants from NWO, KNAW)

Note 3: Research contracts for specific research projects obtained from external organisations,such as industry, governmental ministries, European Commission, charity organisations

PhD candidate: Research capacity amounts to 75% of the appointment/fellowship (all categories except external)

Research staff of Theme One Health

	2015		2016		2017		2018		2019		2020	
	#	**FTE**	**#**	**FTE**	**#**	**FTE**	**#**	**FTE**	**#**	**FTE**	**#**	**FTE**
Scientific staff [1]	19	6.3	18	5.8	18	6.6	19	6.7	20	6.7	20	6.7
Post-docs [2]	14	12.4	15	13.6	17	14.5	17	15.4	15	12.7	10	8.4
PhD candidates[3]												
- Employed	34	-	35	-	33	-	35	-	40	-	50	-
- Contract	15	-	17	-	19	-	19	-	20	-	23	-
- External	15	-	17	-	13	-	16	-	15	-	14	-
Total	**97**	**18.6**	**102**	**19.5**	**100**	**21.0**	**106**	**22.1**	**109**	**19.4**	**118**	**15.1**
Lab Technicians	6	-	6	-	8	-	8	-	8	-	8	-
Visiting fellows	0	-	0	-	0	-	1	-	1	-	0	-
Total staff	**103**	**18.6**	**108**	**19.5**	**108**	**21.0**	**115**	**22.1**	**118**	**20.1**	**126**	**15.1**

#: Total number of staff members

FTE: Research Capacity in Full Time Equivalents (not for laboratory technicians)

Standards for Research Capacity (in case of part time appointment adjustment is needed):

[1]Professor, Assistant Professor and Associated Professor: Research Capacity = 40% of the appointment

[2]Post-doc: Research Capacity amounts to 90% of the appointment (if not otherwise specified)

[3]PhD candidates: number of PhD candidates (both internal and external)

Funding of Theme One Health

	2015		2016		2017		2018		2019		2020		Average	
Funding:							**FTE/%**							
Direct funding (1)	16.3	36%	12.3	26%	15.6	30%	18.2	33%	18.8	34%	20.6	35%	17.0	33%
Research grants (2)	12.6	28%	19.6	42%	20.2	39%	20.7	37%	22.4	41%	22.1	37%	19.6	38%
Contract research (3)	16.8	37%	14.5	31%	15.6	30%	16.3	30%	13.1	25%	16.7	28%	15.5	30%
Total funding	**45.7**		**46.3**		**51.4**		**55.2**		**54.4**		**59.5**		**52.1**	

Note 1: Direct funding by the University

Note 2: Research grants obtained in national and international scientific competition (e.g. grants from NWO, KNAW)

Note 3: Research contracts for specific research projects obtained from external organisations,such as industry, governmental ministries, European Commission, charity organisations

PhD candidate: Research capacity amounts to 75% of the appointment/fellowship (all categories except external)

Research staff of Theme Data and Engineering Science

	2015		2016		2017		2018		2019		2020	
	#	**FTE**	**#**	**FTE**	**#**	**FTE**	**#**	**FTE**	**#**	**FTE**	**#**	**FTE**
Scientific staff[1]	28	7.9	29	8.1	32	8.7	35	9.4	42	11.4	42	12.3
Post-docs[2]	10	7.3	11	7.8	13	9.3	18	14.0	24	19.4	29	24.5
PhD cand.[3]												
- Employed	34	-	36	-	33	-	37	-	37	-	38	-
- Contract	24	-	25	-	30	-	37	-	41	-	40	-
- External	16	-	16	-	15	-	17	-	18	-	19	-
Total	**112**	**15.1**	**116**	**15.9**	**123**	**18.1**	**145**	**23.3**	**162**	**30.8**	**169**	**36.8**
Lab Techn.	3	-	3	-	4	-	3	-	4	-	5	-
Visiting fellows	0	-	0	-	1	-	2	-	0	-	0	-
Total staff	**115**	**15.1**	**119**	**15.9**	**128**	**18.1**	**149**	**23.3**	**166**	**30.8**	**173**	**36.8**

#: Total number of staff members

FTE: Research Capacity in Full Time Equivalents (not for laboratory technicians)

Standards for Research Capacity (in case of part time appointment adjustment is needed):

[1]Professor, Assistant Professor and Associated Professor: Research Capacity = 40% of the appointment

[2]Post-doc: Research Capacity amounts to 90% of the appointment (if not otherwise specified)

[3]PhD candidates: number of PhD candidates (both internal and external)

Funding Theme Data and Engineering Science

	2015		2016		2017		2018		2019		2020		Average	
Funding:							**FTE/%**							
Direct funding (1)	15.5	33%	16.5	33%	15.4	30%	18.1	28%	24.2	31%	26.5	33%	19.4	31%
Research grants (2)	5.2	11%	8.6	17%	9.0	18%	11.0	17%	13.6	18%	13.2	16%	10.1	16%
Contract research	26.2	56%	25.0	50%	26.9	52%	36.8	56%	39.1	51%	41.0	51%	32.5	52%
Total	**46.9**		**50.1**		**51.3**		**66.0**		**76.9**		**80.7**		**62.0**	

Note 1: Direct funding by the University

Note 2: Research grants obtained in national and international scientific competition (e.g. grants from NWO, KNAW)

Note 3: Research contracts for specific research projects obtained from external organisations,such as industry, governmental ministries, European Commission, charity organisations

PhD candidate: Research capacity amounts to 75% of the appointment/fellowship (all categories except external).

To explore the potential of nature to improve the quality of life

The Graduate School PE&RC
Wageningen University Campus
LUMEN Building (100)
rooms A. A.215/A.217/A.221
Droevendaalsesteeg 3-A
6708 PB WAGENINGEN
THE NETHERLANDS
T +31(0)317 485 414
E office.pe@wur.nl

The mission of Wageningen University & Research is "To explore the potential of nature to improve the quality of life". Under the banner Wageningen University & Research, Wageningen University and the specialised research institutes of the Wageningen Research Foundation have joined forces in contributing to finding solutions to important questions in the domain of healthy food and living environment. With its roughly 30 branches, 6,800 employees (6,000 fte) and 12,900 students, Wageningen University & Research is one of the leading organisations in its domain. The unique Wageningen approach lies in its integrated approach to issues and the collaboration between different disciplines.