



WAGENINGEN UNIVERSITY

WAGENINGEN UR

assessment report

Wageningen University

external peer review PE&RC

Production Ecology & Resource Conservation

2015

assessment report

***Research Assessment of the Graduate School
Plant Production & Resource Conservation PE&RC
2009 – 2014***

June 2015

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Preface

This report embodies the findings and recommendations of an international peer review of the Wageningen Graduate School PE&RC undertaken from June 2 to June 5, 2015.

The review consisted of peer assessments of the progress and achievements of the Graduate School as a whole as well as its constituent 17 Chair groups. It is based on a site-visit, interviews and written documentations of PE&RC and Chair groups, including self-evaluations of performance over the past six years. This report is both prospective and retrospective and relies on a combination of quantitative as well as qualitative analyses of the School and its research groups along three prescribed criteria: research quality, relevance to society, and viability. Within this framework, our key objectives are evaluating and improving management, research quality and PhD training as well as ensuring internal coherence and external appreciation.

Although it has been a demanding week with a heavy load of interviews, meetings and an enormous bulk of paperwork to read before we came to Wageningen, we have enjoyed visiting very enthusiastic people and a well-functioning graduate school.

Overall, we came to the conclusion that the successful organization and performance of this School is exceptional in the world. The most convincing pieces of evidence for that were the great variety in the origins of PhD candidates as well as the successful and influential careers they can look forward to after graduating from PE&RC.

We thank the organizers of the site visit for taking good care of us and supporting us with any additional information we needed. We are grateful to Wageningen UR, PE&RC management, academic and library staff, PhD students and postdocs for allowing us a deep insight into both School and Chair groups in a friendly, open and constructive atmosphere. All of us have profited from this unique experience. It is the sincere wish of the assessment panel that this report contributes to further developing PE&RC for maintaining or even increasing its already excellent quality.

June, 2015

Prof. Dr. Volkmar Wolters
Chairman, International Peer Review Committee PE&RC

1. Introduction

1.1 The evaluation

All publicly funded university research in the Netherlands is evaluated at regular intervals in compliance with a national standard evaluation protocol (SEP 2015-2021), 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 a systematic external peer review conducted every six years and a three-year interim review, often based on an internal self-reflection, focused on what is achieved since the last external peer review.

The evaluation system aims to achieve three generic objectives:

- *improvement* in the quality of research through an assessment carried out according to international standards of quality and relevance;
- *improvement* in research management and leadership; and
- *accountability* to the higher management levels of the research organizations and to the funding agencies, government and society at large.

Moreover, these reviews at Wageningen University include another objective. The university requests a formal recognition of the activities of its graduate schools, as the ECOS-KNAW that was responsible for accrediting the graduate schools in the Netherlands has ceased to exist as of 2015. The SEP includes a terms of reference for the reflection on the PhD program of the graduate school. For the formal recognition of its graduate schools, Wageningen University requests to indicate whether its graduate schools comply with the following conditions:

1. The graduate school provides a well-organized, coherent and productive research environment for the PhD program.
2. The graduate school offers a sound and institutionalized program in which students are trained to become independent researchers.
3. The graduate school functions as an independent organizational unit with its own budgetary and managerial responsibility, with the university or universities involved providing a level of financing for a period of at least six years that can be described as sufficient in view of the research school's planned capacity.

These conditions comply with the previous ECOS-criteria as well as with the special conditions set by Sodola, the Dutch network of accredited research schools in all fields of academic research.

In early 2015, the European University Association (EUA) was invited by Wageningen University to conduct an evaluation of the generic elements of its doctoral education, with the aim of determining whether:

1. The intended learning outcomes of the Wageningen PhD program meet international standards.
2. The Wageningen PhD program has the structure and processes in place for PhD candidates to attain these learning outcomes.

Therefore, results of the EAU evaluation contribute to the current review, which focuses on the quality of the graduate school and specific elements of the PhD training program (appropriate research environment, the course program, the day-to-day PhD supervision etc.).

This assessment deals with the performance of the graduate school and in particular the position of its research (chair) groups within the (inter)national science and PhD education arena (retrospective) and identifies ways for further improvement (prospective).

1.2 The assessment procedure

The evaluation procedures followed by the Review Committee were those set out in the NWO/VSNU/KNAW “Standard Evaluation Protocol 2015-2021 for public research organizations”. This protocol entails two main characteristics:

- *Two levels of assessment:* The assessment takes place at two levels of the research organization (*i.e.* the level of the graduate school and the level of chair groups);
- *Three main criteria:* The chair groups are assessed on the three assessment criteria (*i.e.* research quality, relevance to society, and viability).

The evaluation committee was requested to report its findings on the chair groups in line with the three main criteria. With respect to the evaluation of PE&RC, the findings should be reported in a descriptive terms. For the assessment of the research (chair) groups, the results of the assessment should be given both in scores as well as in descriptive terms. In the text, the most important considerations of the committee should be clarified, while the conclusion should be summarized in a single discrete score according to a four point scale (Annex 1). An excerpt of the standard evaluation protocol was provided as a tool supporting this assessment. The four criteria should always be reviewed in relation to the group’s mission, especially if this mission restricts the group to operate only for / in a national scientific community.

The assessment was based on and supported by three main components of evidence:

- self-evaluation reports detailing the operation, management, research activities, outputs, and SWOT analysis of the graduate school, and its chair groups; these self-evaluation reports were written as prescribed in the national standard evaluation protocol;
- internet-references of the selected papers and dissertations from each research/ chair group to allow the committee to examine in detail examples of published work;
- discussions with boards, PhD students and council, postdocs, academic and library staff, and research managers about the information provided.

The site visit was undertaken during the period 2 June - 5 June, 2015 and consisted of a number of components, which can be summarized as follows (Annex 2):

- a plenary introduction to Wageningen University and the PE&RC graduate school by the Dean of Sciences, the director of PE&RC, library staff, the executive secretary of PE&RC and the PhD program coordinator;
- sub-committee interview sessions with all individual chair groups (leaders and key staff);
- a meeting with the PE&RC PhD candidates and PhD council
- a meeting with postdocs
- meetings with (in one case the representative of) the director general of the two Sciences Groups involved
- a final plenary debriefing meeting with the PE&RC Board, Dean of the Wageningen Graduate Schools and the Rector Magnificus

The Peer Review Committee comprised 9 peer members and a secretary (Annex 3). The final report with the conclusions and recommendations was formulated according to the

formats that have been provided to the peer review committee. The draft report was presented to the director of PE&RC to redress any factual errors.

1.3 Results of the assessment

This report summarizes the findings, conclusions and recommendations of an international peer review of the PE&RC graduate school undertaken in June 2015. The peer review covered the period between 2009 and 2014.

The assessment of PE&RC and its chair groups was based on and weighted according to the rationale explained in Annex 1. This means that the performance of the groups was benchmarked against the performances of other groups in the global arena of comparable disciplines. The conclusions, as presented in chapters 3 and 4 of this report, follow the structure and criteria that are formulated in the Terms of Reference, Annex 1. Chapter 3 gives an assessment of the performance of the graduate school PE&RC and Chapter 4 elaborates on the performance of its individual research (chair) groups.

1.4 Quality of the information and suggestions for future reviews

Overall the information provided to the panel was very useful and well structured. The bibliometric analysis was highly elaborated and carefully constructed. It provided a helpful overview of the publication activity and international impact of PE&RC. However, group-specific benchmarking based on graphical comparisons between own bibliometric data and those of other groups often was confusing and impossible to prove. PE&RC should continue to work with the library staff to ensure that bibliometric data are calculated and presented in a consistent and reproducible way.

The SWOT analyses included in the reports of the individual research groups were clear, well thought out, honestly done and inspiring. However, the amount of paperwork was enormous (68 pages Part A and about 550 pages Part B of the self-evaluation plus about ten voluminous appendices at the secured website). The presentations by the individual research groups provided a nicely condensed overview of team-specific mission, targets and performance. Some presentations (especially at PE&RC level) were nevertheless redundant, since they did not provide complementary information to what was already known from reading the self-evaluation reports, which reduced the time available for interviewing.

As a suggestion for upcoming site visits, we recommend to cautiously shorten the time spent on meeting PhDs and postdocs, as it altogether consumed 4 hours with PhD students and 1.5 hours with postdocs in a very tightly scheduled week of around 20 interviews and resulted in unexpected and counter-productive complications from the partial overlap with the EPS assessment. Nevertheless, the committee enjoyed the personal communication with PhD students and postdocs and considers these talks to be very informative and productive. However, compressing this exercise would leave more time for preparing interviews and writing draft reports, and a better representation (e.g. of sandwich PhD students) would support the evaluation process. The review could also benefit from an additional half-day with the panel.

The committee detected some information gaps regarding certain aspects of the PE&RC policies, which should be filled for future reviews. For example, we could not fully comprehend the consequences for tenured staff members of not meeting a minimal quality level. In addition, the specific association of research staff to PE&RC was not clear in some

cases (e.g. is there staff outside the school but inside the research groups?). Similar questions were raised concerning PhD candidates that do not finish their thesis within their contract period. However, lacking information concerning these issues was provided upon request.

2. Structure, organization and mission of PE&RC

2.1 Introduction

The Graduate School Production Ecology & Resource Conservation (PE&RC) is a collaborative research and PhD training institution, coordinated by Wageningen University (WU). Participants in PE&RC are staff, postdocs and PhD candidates from Wageningen University, Utrecht University (Ecology & Biodiversity group), Naturalis Biodiversity Center (NBC), and the Netherlands Institute of Ecology (NIOO). The central focus of the collaboration is the PhD program that is embedded in a coherent and productive research environment that aims to perform frontier academic research of the highest quality. In April 2015, PE&RC had 394 registered PhD candidates, 55 postdocs and 180 staff members. PE&RC provides an interactive platform for scientists and PhD candidates to stimulate interaction and communication.

2.2 Mission of the Graduate School

The ambition of PE&RC is to stay at the international forefront of the scientific field it operates in, tackling both cutting-edge fundamental and societal relevant research and PhD training within its mission:

“Understanding the functioning of (agro-)ecosystems to design and enable the development of sustainable and multifunctional production and land use systems”.

This involves research on sustainable production, biodiversity and ecosystem services, bio-based economy and multifunctional land use, addressing various global crises, such as food security, climate and biodiversity loss.

The (agro-)ecosystems within PE&RC cover the full range from intensive agricultural production systems (e.g. greenhouses) to extensive semi-natural and natural systems (e.g. agroforests, wetlands, savannas and protected areas). Bio- and geosciences are corner stones of PE&RC research on agro- and (semi-)natural ecosystems. To understand these systems, they need to be investigated at various spatial and temporal scales and at different levels of biological integration and complexity. Thus, PE&RC research challenges are to:

- Understand the complexity of ecosystems and derive unifying concepts;
- Develop quantitative approaches in which observation, experimentation and modeling are combined and different scales of observation are quantitatively connected and synthesized;
- Integrate the different disciplines required and design novel production and land use systems in relevant temporal and spatial configurations.

Supporting technologies and approaches, such as genomics, plant-phenotyping (geo)-information systems, remote sensing as well as novel statistical and modeling practices are an integral part of the research activities. Moreover, an interdisciplinary research approach including input from socio-economic sciences is essential for, among others, the design and development of sustainable and multifunctional land use systems. As socio-economic sciences are not part of PE&RC, the School communicates and collaborates with these sciences extensively, inter alia through the relevant Graduate Schools.

Within Wageningen University the tasks of PE&RC are to:

1. Develop, coordinate and facilitate education and training of PhD candidates;
2. Improve and safeguard quality of academic research (PhD candidates, postdocs and academic staff); Besides quality control related to the PhD program, PE&RC interacts with the research groups of Wageningen University related to scientific output, impact and the research process;
3. Stimulate the development of a coherent academic research program, with accompanying strategic research plans, and to act as a national platform within its field. To this end, graduate schools receive strategic funds. Moreover, Graduate Schools are in a formal position to advise the Executive Board of Wageningen UR on the appointment of new full professors and special professors and on strategic plans of Wageningen UR.

2.3 Management and organization

The PE&RC Board is responsible for the functioning and performance of the Graduate School. It is composed of six members, three professors of Wageningen University, a representative from the Netherlands Institute of Ecology, a representative of the Naturalis Biodiversity Center, and the chair of the PE&RC PhD Council (PPC). On average, the Board meets twice a year.

The Board receives advice on research matters from the Research Committee and on education matters from the Education Committee. Furthermore, the board is advised on strategic matters by the PE&RC PhD Council (PPC), the Scientific Advisory Council (SAC), and the International Advisory Board (IAB). See figure 2.1

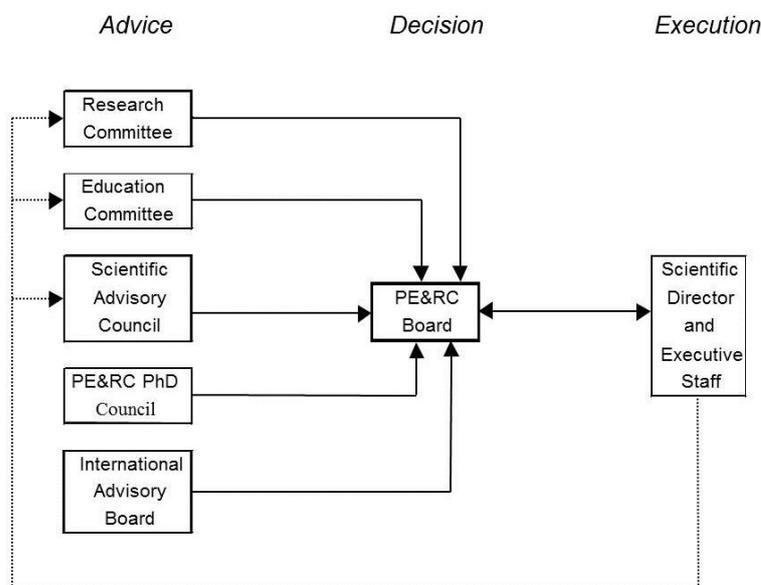


Figure 2.1: Organizational scheme of PE&RC

The Scientific Director of PE&RC is responsible for the day-to-day management of the Graduate School. He is responsible for the scientific and educational performance of PE&RC and reports to the PE&RC Board and the Executive Board of the Wageningen UR. He is supported by an executive secretary and a PhD program coordinator (who jointly deal with 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 coordinator, the PE&RC Board and Committees, both at their request and on its own initiative. Additionally, the PPC serves as a "Knowledge and Experience Base" for new PhD candidates. The PPC does so by organizing the annual PE&RC Day and by assigning experienced "Buddies" as mentors to facilitate the arrival and quick acclimatization of new PhD candidates at the Graduate School PE&RC. The PPC meets once a month.

PE&RC encompasses 21 research groups of Wageningen University (Table 2.1).

Table 2.1: PE&RC research groups and their chair holders (full professors)

<u>Plant sciences</u>	
Research Group	Chair holder(s) (full professor)
Centre for Crop Systems Analysis (CSA) ¹	
Crop and Weed Ecology	Niels Anten
Crop Physiology	Paul Struik
Entomology (ENT) ²	Marcel Dicke
Farm Technology(FTE) ³	Eldert van Henten/Peter Groot Koerkamp
Farming Systems Ecology (FSE)	Pablo Tittonell
Genetics (GEN) ²	Bas Zwaan
Horticulture and Product Physiology (HPP)	Leo Marcelis
Mathematical and Statistical Methods (MAT)	Fred van Eeuwijk/Jaap Molenaar
Nematology (NEM) ²	Jaap Bakker
Plant Production Systems (PPS)	Ken Giller
Plant Breeding (PBR) ²	Richard Visser
Virology (VIR) ²	Monique van Oers
<u>Environmental sciences</u>	
Research Group	Chair holder(s) (full professor)
Forest Ecology and Management (FEM)	Frits Mohren
Geo-Information Science and Remote Sensing (GRS) ¹	
GIS	Arnold Bregt
Remote Sensing	Martin Herold
Nature Conservation and Plant Ecology (NCP)	Frank Berendse
Resource ecology (REG)	Herbert Prins
Soil Biology and Biological Soil Quality (SOQ)	Lijbert Brussaard
Soil Geography and Landscape (SGL)	Jakob Wallinga
Soil Physics and Land Management (SLM) ⁴	Coen Ritsema
<u>Animal Sciences</u>	
Behavioural Ecology (BHE) ³	Marc Naguib

1) Two groups within one laboratory.

2) Assessment together with Graduate School Experimental Plant Sciences (EPS).

3) Two groups (BHE and FTE) participate within both the Graduate Schools WIAS and PE&RC. BHE is assessed within the Graduate School WIAS; FTE is assessed within the Graduate School PE&RC.

4) SLM has been evaluated as part of the evaluation of the graduate school WIMEK/SENSE in 2014.

3. Performance of the Graduate School PE&RC

3.1 The research environment for the PhD program

The Graduate School Production Ecology & Resource Conservation (PE&RC) is effectively structured for meeting its mission of “*Understanding the functioning of (agro-)ecosystems to design and enable the development of sustainable and multifunctional production and land use systems*”. By conducting fundamental and applied research on the sustainable increase of agricultural production in collaboration with diverse societal partners, PE&RC is ahead internationally in the translation of basic research to applications.

It is obvious that such an ambitious target can only be reached by attracting, inspiring and educating a new generation of researchers, practitioners and decision makers that is willing to carry the mission (and vision) into the future either by continuation of doing integrated science for agricultural sustainability or by transmitting the achievements of this approach to society. Thus, the PE&RC concept of combining cutting-edge research with excellent education, training and support of PhD candidates and postdocs is outstanding. The way all this is linked to strategic targets/visions is commendable. A good example is the involvement of PE&RC in the establishment of the WUR ‘Taskforce Ecology’ in 2013.

The scientific strategies of the graduate school are very effective. They are greatly appreciated by both staff and students, since they provide added value. This is possible, because management, leadership skills, and organization of the graduate school are excellent. The overarching organizational structure and the management concept are very well thought through and implemented professionally. Though PE&RC evidently runs smoothly and successfully, the review panel was confounded to some extent by the extraordinarily complex structure of committees, boards, councils and responsible persons, which was even more complex when complementary WUR structures come into play. This raised some concern about an inherent risk of over-organization.

The research groups are mutually supportive with teams generally having a good spirit. Not surprisingly, philosophies for successful research vary among the groups, but this is not detrimental. Independent of this diversity, the performance of all groups is excellent within the broad field of ecology, which is always a challenge. Collaborations within and around the WUR complex are varied, but generally successful. However, there is some overlap between research groups, which requires attention to avoid competition through knowledge exchange and openness. Having pointed to this potential jeopardy, the panel wishes to emphasize that a certain degree of overlap between PE&RC groups bears an enormous potential for accelerating progress in a challenging scientific field through cooperation, exchange of ideas and complementary perspectives. This potential should be used more intensively and could become much more elaborated. In the field of nature conservation, some groups complement each other so strongly – without redundancy though - that scientific and educational potential could be significantly increased by merging the respective groups to form a larger entity with a much higher capacity. Though there might be additional options for doing so, the assessment committee had the impression that this particularly applies to the ‘Nature Conservation & Plant Ecology Group’ and to the ‘Resource Ecology Group’

The assessment committee was impressed by the successful implementation of most recommendations provided by the Peer Review Committee in 2009. For example, the advice to publish in higher impact journals really worked across many research groups. Those that had already achieved this goal between 2003 and 2009 continued on a high level or even raised it, and now almost all groups have made good progress in this regard. The new tenure

track system seems to contribute significantly to this success story. All in all, the development of PE&RC from 2003 through 2009 to 2015 led to an impressive increase in quality and quantity of research. In response to a gentle critique of the previous panel on the research themes of 2009, PE&RC has worked hard to further develop its research topics. Building on the themes suggested by the Taskforce Ecology for WUR as a whole (ecology for sustainable natural resource use, ecosystem resilience in a changing world, disease ecology, spatial ecology, species adaptation to a changing world), four new partly overlapping themes were identified:

- Systems Biology
- Bio-/geo-interactions and Biodiversity
- Complex Adaptive Systems
- Innovative Nature

It appeared to the committee that these themes constitute a not very operational mixture of research fields, methodological approaches and good intentions. The committee was thus delighted to learn that PE&RC has used the themes as stepping stones for selecting three rather broad focal areas, which are planned to guide interdisciplinary research and scientific exchange within the next 3-6 years:

- Learning from Nature
- Global Change, Food and the Environment
- One Health

These focal areas bear several similarities to the priorities set by new international programs such as “Future Earth” and thus provide a good opportunity for PE&RC to link to large research initiatives. For doing so, however, it might be wise to address topics such as sustainability and regionalization more explicitly.

PE&RC has a high average level of productivity and impact across a large number of groups. Societal relevance of the research done at the school is beyond doubt, with strong engagement within the Netherlands, and in Europe and particularly in Africa, Asia and Latin America. There are many different models for the chair groups to deliver applications of their research, and these differences unavoidably and harmlessly reflect individual preferences of the people involved as well as disciplinary constraints. The level of engagement with industry, private companies and stakeholders is high. All the groups in the ecology area deliver strongly to development and influence capacity building in developing countries. This is very positive and should not be changed, but it must be pointed out that a very strong focus on societal outcomes provides a risk that ‘fundamental’ science becomes ‘too applied’.

Concerning monetary resources, the committee noted that the organizational framework of the Graduate School has been established on a solid financial basis, which covers funding for the director, coordinators and secretary. In addition, PE&RC receives earmarked funds from the university to finance, for example, courses, seminars, visiting scientists and strategic PhD positions. Furthermore, the school generates its own revenues by charging registration fees from incoming PhD students. Chair groups have a varied - on an average large - income from competitive temporary funds (national, EU, public, private and public-private, respectively), with the majority of the 17 groups being financed through such grants (2/3 - 3/4 of the budget). The assessment committee had some concerns about the comparatively low share of funds for basic research (< 10% of their income for many groups, cf. tables 2.2 within Part B of the Self-Evaluation Report). Moreover, it identified some risks for the future sourcing of PE&RC. First, revenues may decrease due to a numerical decline of PhD candidates (not only because of the external pressures to shorten PhD projects, but also because of increasing competition with other universities world-wide). Then, considering the specific skills that are needed for carrying out cutting-edge ecological research,

temporary funding might not allow to employ very experienced staff for a sufficient period of time. And finally, there does not seem to be a reliable mechanism for adjusting the PE&RC budget to a level that enables the school to keep pace with the permanent progress of methods and scientific innovations that is typical to the young arena of sustainability research.

More important than financial resources are the human resources. The committee acknowledges the efforts of PE&RC to attract more female senior scientists. It is nevertheless extremely disappointing – and actually not acceptable – that several vacant chair positions have been filled over the last 6 years with very little impact on the gender imbalance at the senior level (exception: Virology). Progress on this issue must be made in the near future, when vacancies are to be filled with excellent staff.

The viability of PE&RC is very good. The school is excellently equipped for the future and its scientific visibility and recognition are excellent. The effectiveness of support provided by the organizational framework is beyond doubt. The school adheres to an ambitious future-oriented mission and the research lines followed by the constituting chair groups are highly viable. PE&RC as a conglomerate of different environmental-oriented disciplines is unique to the world in its innovative strength. Several impressive strategic choices and decisions have been made for safeguarding the school into a very promising future.

The assessment committee concludes that PE&RC is a viable, future-oriented, very productive and globally unique research school that creates a vibrant scientific environment for the PhD program.

Recommendations:

- To simplify the organizational structure in close agreement with WUR. For example, some functions of the various PE&RC committees could be combined.
- To develop a mechanism for regularly validating and adjusting the three focal areas of research.
- To urgently make optimal use of overlaps among chair groups. The focal areas could be used as a template.
- To merge the 'Nature Conservation & Plant Ecology Group' and the 'Resource Ecology Group' for generating a scientific entity of higher capacity in the field of nature conservation. Since these two groups are complementary but not overlapping, this process should happen without a reduction of chairs, staff and resources.
- To establish a policy for avoiding adverse effects of competition among groups for external funding opportunities.
- To raise the awareness for potential negative effects of a strong focus on societal outcomes upon basic research. For example, by regularly addressing this issue in seminars or during PE&RC weekends.
- To better exploit options for obtaining personal grants, as this is a possibility for increasing the overall level of funding of fundamental research.
- To better guarantee that very experienced supporting staff, which currently is employed on the basis of temporary funds, is available for a sufficient period of time. In particular regarding ecological research.
- To intensify efforts dramatically to reduce the imbalance in gender among chairs as soon as possible.

3.2 PhD and postdoc training and education program

Preliminary remark: an overall evaluation of the WUR PhD program can be found in the EUA Solutions Report (01.2015). The results shall not be repeated here.

○ PhD course program of the graduate school

PE&RC attracts five main types of students (Junior Researcher, Guest PhD, Sandwich PhD, External PhD, and staff PhD) from over 160 countries with a wide range of backgrounds. The assessment committee appreciates a positive trend towards a more balanced gender representation.

It is evident that the PhD course program of PE&RC must take account of the enormous diversity of the students attending the school. Against this background, several key areas of benefit were identified by the panel:

- Courses are highly interactive and well organized, and the backpack funding provides flexibility for attending these as well as conferences and other academic events.
- Interdisciplinary skills are being developed (e.g., through discussion groups organized by PhD candidates).
- The Training and Supervision Plan (TSP) is key to the success of PhD students. Elements of the PhD program are highlighted in the three PE&RC weekends using a personal participatory approach.
- A buddy system is provided to introduce newcomers to the PhD program.

The PhD course program covers a wide range of specialties within the different chair groups. Interdisciplinary interaction between groups is encouraged by PE&RC via discussion groups, symposia and seminars. These can fall under the realm of a focal area, as "One Health", but not necessarily have to be so. The program is supported by a large number of short courses (e.g. statistics, mapping and GIS, modelling, writing, presenting) as well as other TSP activities (e.g. conference visits, discussion group meetings, teaching), with a total of 32 credits (approximately 0.3 per day) being required over the period of the PhD project. This provides a target for the students, but also allows them to obtain the skills they need for completing their studies and for planning their careers. The underlying structure adheres to the concept of T-shaped skills (depth and breadth). Sandwich students are offered attendance of certified courses in their country of residence. In general, PhD's can follow courses elsewhere, as long as supervisors agree with the quality of the course.

Authorship of journal articles was brought up as an issue by the PhD council in 2014. PE&RC followed the recommendation of the council to include authorship policy as a mandatory point of discussion into the TSP. Concerns remain, however, about co-authorship claimed by international supervisors. In cases when supervisors significantly contribute to the papers, uncertainty may arise about the level of the candidate's own contribution, which may be most clearly judged through the content of the introduction and discussion/synthesis of the final thesis.

The funding of sandwich PhDs has been critically affected by changes in taxation laws, which also influenced the financing of local PhDs. If local PhDs will be reclassified as students, the situation for WU will change dramatically, not only financially but also regarding the time to finish a thesis particularly in the area of agriculture or ecology.

Recommendations:

- To require an English proficiency test at the start of the program (< 1 year). An intensive program should be offered for those who cannot get their English language skills up to speed in their own country.
- To make a formal agreement with international supervisors on the authorship policy before the PhD project starts
- To address the problem concerning the level of the candidate's own contribution to publications that are part of the PhD-thesis. For instance by implementing a policy to explicitly document the level of collaboration within thesis chapters such that the contribution of the student to the thesis can be better evaluated, *i.e.* in the same way as several journals now require this information.
- To further increase efforts for achieving a more balanced gender representation.

○ **Quality of the PhD progress monitoring**

The TSP provides a structure to supervision, which is highly innovative and works very successfully. The Go-NoGo process is an effective tool for early stage monitoring of progression and provides an avenue for students to withdraw or advance the progress through the PhD program. The PhD council maintains a monthly meeting schedule and raises key issues in relation to the graduate program. The value of the PE&RC weekends was recognized in training PhD candidates on how to communicate with their supervisors.

Recommendations:

- To include an agreement of the international supervisors into the initial evaluation of the project proposal.
- To continue or even extend annual performance and development evaluations as these help the PhD's to develop clear directions and goals. They ensure that the latter are maintained/fulfilled.
- To pay more attention to the performance at later stages of the project, in particular once PhD's have passed the four year funding period. It is recommended to establish some kind of monitoring process.
- Many of the PhD candidates are international, and come from diverse academic backgrounds and different cultures. They need more attention than domestic PhD candidates, and care must be taken to ensure that the professors receive adequate help from support staff, especially in relation to pastoral care.

○ **Efficiency of program**

A major concern is that funding tends to be increasingly confined to three-year periods, whereas WUR is intent on maintaining four-year PhD projects. A critical question within this context is, whether funding of PhD projects by the NWO will change towards periods of 3 years. This may have enormous implications for the Wageningen program, since a decline of PhD numbers would reduce PhD completion funding for the research groups.

Most PhD's have the opportunity to supervise Master's students. This fosters the exchange of ideas, interdisciplinary discussions and the development of skills. The committee considers this to be a very promising opportunity for training people, who are heading for supervisory positions in any institutional environment, though the training and coaching aspects could be more formalized for maximum benefit.

The program coordinators play an essential role in the Graduate School and are key to its success. The interaction and trust gained by the PhD's is high, and they are empowered to address issues relating to supervision. Group chairs highly praise this program.

Recommendations:

- To address the problems resulting from the discrepancy between funding periods and duration of PhD projects. Some sort of forward planning is needed to bridge the gap for PhD's with three years of funding.
- To develop a strategy for timely meeting eventualities associated with the funding strategy of NWO. The panel recommends to monitor the later stages of the projects more intensively for reducing the average duration of the PhD's. A standard evaluation after 2.5 years should be followed as this may help to bring down the average duration.
- To continue on and to further elaborate the strategy of Master students being supervised by PhD's.
- To make the training program for supervisors compulsory.
- To recognize the pivotal role played by the program coordinators and support them as much as possible.
- To pay more attention to linkages and communication with supervisors located in other countries. The degree of this problem seems to vary with project and group, but it is nevertheless recommended to take action.

○ **PhD career prospects**

Support given to the students in terms of career planning and transition is considered to be excellent. Many students remain within academia/education, but a considerable number is also employed by governmental/public institutions and private companies. Recent employment rate has been reported to be close to 98%. This confirms the outstanding success of the School.

○ **Postdocs**

The assessment committee was impressed by the attention given to postdocs – and impressed by the increase in the number of postdocs since the last assessment. They are much too often a 'forgotten group' at universities. The new Postdoctoral Policy is exceptional and the Program has become an integral component of the PE&RC research environment. It offers four modules aimed at training and coaching postdocs for careers inside and outside academia.

The new tenure-track system works very well at providing an attractive career path to highly ambitious individuals. However, it seems not to be compatible with dual career situations and family.

Recommendations:

- To promote communication among postdocs (e.g. postdoc council, social events).
- To consider renaming the postdoc program to 'professional development plan'. The committee saw a certain risk of several postdocs not willing to make optimal use of the unique opportunities provided by the program. Since they consider themselves as full-fledged scientists, they might not want to be treated as students anymore.
- To offer a part-time tenure-track option for those with families. Similarly, a more teaching-oriented stream could be developed for people who do not want to become personal professors.

- To develop vision and strategy for leveraging the alumni network (e.g. to provide mentors for new sandwich students in their home countries).

3.3 Integrity

The committee concludes that the Graduate School PE&RC has taken the issue of Academic Integrity very seriously by implementing the following six approaches:

1. It follows and discusses the Netherlands Code of Conduct for Scientific Practice at all levels.
2. It follows the Wageningen UR Integrity Code (mainly on accessibility of research results).
3. It consults and participates in committees on integrity (e.g. for Animal experiments).
4. It has implemented recommendations for co-authorship.
5. All research groups have drawn up a plan for data management.
6. The Graduate School organizes sessions on scientific integrity and offers courses for PhD students on various relevant ethical issues (e.g. Ethics and Philosophy in Life Sciences).

The committee notes that all 17 Research groups involved in this PE&RC assessment are not only aware of the policies and guidelines on Academic Integrity of the university, but also actively contribute to them by various practices in their own group.

3.4 Overall conclusions (qualitative assessment) PhD and Postdoc policy

PE&RC has established a world class and unique PhD program that includes high quality postdoc training. It is very well thought through and implemented professionally. The graduate school provides a well-organized, coherent and productive research environment for the PhD program. The committee was impressed by the intensity with which PE&RC cares about its students. The school offers a sound and institutionalized program in which PhD candidates are trained to become independent researchers. The level of attention given to the career development of postdocs is outstanding. Following the recommendations provided by the assessment committee in the previous section will help to maintain and further increase the already excellent quality.

The graduate school functions as an independent organizational unit with its own budgetary and managerial responsibility. The PE&RC approach looks very expensive with all the staff involved, but apparently has a good reward. The institutions involved provide a level of financing for a period of at least six years that is sufficient in view of the graduate school's planned capacity. Resources are of course limited, but excellent results and considerable international collaborative PhDs justify any investment.

4. Assessment of the Chair Groups

4.1 Crop Systems Analysis

Research Group: Crop Systems Analysis (CSA)
Leader research group: Profs. Paul Struik, Niels Anten
2014 Research input tenured staff: 3.2 FTE (9)

Score	Research quality	2
	Relevance to society	1
	Viability	2

Motivations for scores:

Research quality

CSA is a very influential group in this area of science, and covers a wide range of topics in a coherent way, which also links their work closely to a delivery pathway, as evidenced by many PhD candidates having co-supervision from social science groups. According to bibliometrics, the group operates above world average, and scores well in quartile 1 journals, with strong impacts via PhDs. There is no real concern over the later year decline in RI as it takes time for CSA citation given the periods needed for experimentation. The group actively encourages PhD candidates to publish, including in relevant Q2 and Q3 journals which can also affect impact estimates. There have been two major improvements since the previous review: increase in publication impacts and efforts for targeting larger projects (including projects from national scientific foundations).

The modelling research in Theme 1 (crop system biology) is of high quality. It is well supported by a new appointment focusing on the area of modelling photosynthesis. The group is working toward the integration of genetics into crop models, but there is still some need to better understand how such genetics and such models can be best utilized in breeding. At present, the main use is to propose 'ideotypes' and 'marker-based prediction' for different environments. Since this is only a small part of the prioritization work in breeding programs, the group is starting to move toward better integration with high throughput phenotyping by developing strong links to barley and rice research teams elsewhere. Theme 2 (plant form and function) research has developed well with new commitments since the previous review, and the group are leaders in FSPM (functional structural plant modelling) with their work being developed for multiple species and applications within the group and with other chairs (e.g. HPP). The new Crop and Weeds Chair appointment has begun well and is clearly contributing across multiple themes, particularly 2 and 3 (functional diversity). As with Theme 1, some high profile papers have boosted the group's performance, with the FSPM work facilitating the construction of new hypotheses in basic plant research ('plant neighbor' interactions) and increasing the capabilities of Theme 3 by allowing the exploration of novel solutions for intercropping and crop-weed control through effective modelling of population dynamics and crop management interactions. Much of the research on this issue is done in China and Africa in systems where intercropping can often be shown to have a greater per area yield in intensive systems. To expand intercropping, European agriculture still requires new technological solutions for farm operations that may come in the future, so for now European studies consider mainly cover crops. Via Theme 5 (synergy with social sciences), the group also contribute to the 'agronomy' of breeding with extremely successful work in developing 'clean-seed' systems for potato production in Africa while Theme 4 (spatial agroecology) utilizes models in a spatial context to look at landscape impacts on disease resistance and control in crops like wheat, as well as risks for invasive species, including weed-resistant GMOs.

Relevance to society

This group has an outstanding relevance globally. They train large numbers of graduates in cropping system analysis, who are in high demand in European and international (development) agriculture. The sandwich PhD programs are effective in providing training to undertake high quality experiments in relevant cropping systems. They are aiming to work more with stakeholders to think about solutions, rather than to only venture opinions. Many PhDs are co-supervised by staff in social science areas. Their research delivery portfolio is extensive with software solutions and training being of high quality and uptake. The group is well engaged in research and training with international partners, providing many of the needed graduates in cropping systems research throughout the world.

Viability

There are large numbers of opportunities for collaboration within PE&RC, especially with HPP, PBR and MAT, with CSA aiming to build links from physiology (PERC and EPS groups) through to crop production on the farm. There are several joint PhDs with EPS via PBR and the plant and animal physiology groups. Links with the Environmental Sciences School emphasize interactions of ecosystems with agriculture systems, and how these impact on the productivity and sustainability of agriculture. The Chair noted that the group was currently addressing issues related to delays in some PhD completions, especially sandwich PhDs, and that a scientist has been assigned to propose actions to overcome issues that were identified. Data management protocols are in place, and this ensures future viability of modelling, providing a reliable set of underlying scientific information to continually improve models. In terms of funding, the group has been increasing the number of post-docs and building up the tenure track opportunities, which is essential given the great increase in PhDs (from 20 to 40) over the review period. The main challenge for CSA is to develop its links with other groups and institutions, in particular as related to building opportunities for studies in relating genetics, breeding and phenotyping with modelling research.

Other remarks

Since the previous review, actions have clearly been made to improve the mapping of pathways to policy impact (Theme 5), and to demonstrate the value of FSPM (Theme 2) in molecular and breeding applications. CSA remains central to the identity and reputation of PE&RC and is one of the leading benchmarks in this area.

Recommendations

To create linkages to breeding programs in WUR or elsewhere for delivering novel outcomes in:

- utilizing plant models to understand adaptation and contribute to the targeting of breeding,
- demonstrating the utility of FSPM approaches in phenotyping and working with HPP and GRS in applying or integrating with measurement technologies.

4.2 Entomology

Research Group:	Entomology (ENT)
Leader research group:	Prof. Marcel Dicke
2014 Research input tenured staff:	2.4 FTE (8)
Score Research quality	1
Relevance to society	1
Viability	1

Motivations for scores:

Research quality:

The group is, without question, one of the most influential entomology research groups in the world, especially considering the relatively small number of tenured research staff (8). Their research consists of a well-balanced combination of basic, curiosity-driven research side-by-side with the application of knowledge derived from these studies to solving problems in the real world. The eight tenured research staff members carry out this important research together with non-tenured scientific staff, 13 postdoctoral fellows and 40 PhD candidates. During 2009 – 2014, 40 candidates received a PhD.

Documentation of the very high quality research carried out by this group is found in publications, which include more than four hundred papers over the current review period. Of these, over 120 papers are among the top-10% in widely cited journals, and 18 of these are in the top 1%. Moreover many of these are in excellent to highly prestigious journals such as Science, Nature Climate Change, Nature Chemical Biology and PLoS journals. Productivity per person in the group is exceptional; 2.3 papers per full time equivalent staff (over the last 2 years) per year, which is fourth among the 17 chair groups being evaluated in this cycle. The quality of the group has been recognized at a national level with 3 staff member of the KNAW and Marcel Dicke has been recognized with the award of the NWO-KNAW Eureka prize for Science communication and the Spinoza prize. Members of this group include three fellows of the Royal Academy of Sciences (KNAW). Owing to the high quality of their research, the Entomology group has been very successful in attracting competitive funding in both the local Dutch funding agencies (VWV; NWO, KNAW) and the EU. Approximately 54% of funding comes from competitive research grants and 27% from contract research.

A novel aspect of this group's activities is the promotion of insects as highly nutritious supplements for animal feed and even as components of human diets. This research is done with an international focus and helps the FAO in their policy to improve protein supplement to feed and food. The leading position of the group in this area becomes visible, e.g. with establishing a new scientific journal (<http://www.wageningenacademic.com/loi/jiff>).

Relevance to society

The group has an excellent record of undertaking research relevant to society both nationally and internationally. At the national level they have developed effective integrated pest control programs for controlling insect pests with biological control agents for both the glasshouse crop systems and field crops. They have several important international research programs and collaborations in, for example, countries in Africa, South America, China, as well as in developed countries such as France, Italy, and the United States. Their studies of insect-plant interactions provide information being used to structure improved and sustainable integrated pest management programs for controlling both crops pests and the mosquito vectors of human diseases such as malaria.

An important aspect of this group's activities is the high profile they have developed in the public through a variety of outreach programs. They have developed a biannual lecture series entitled "Insects and Society," and routinely participate in radio and TV interviews on the biology of insects as well as their economic and medical importance. They also participate in collaborative research programs with other PE&RC groups such as Virology, Genetics, and Nematology.

Viability

The group is well led and has a clear focus in fundamental work that connects well with other groups in EPS & PE&RC. The budget that supports staff (48%) means the group is not dependent on "soft" money (competitive grants and contracts) for support. The average age of key group members is 55, and the younger professionals are under 40. Thus there is an important age gap that should be dealt with. The group has a strategy for development of entry-level professors in the future and will make an appointment of a young tenure track staff member at the assistant Professor level in the near future. A major concern is that the group still consists mostly of males, thus major efforts should be made to correct the gender imbalance.

Recommendations

- To make efforts to improve both knowledge and use of molecular biological techniques for the benefit of the staff, post-doctoral fellows, and PhD candidates through development of stronger contacts and training of staff and PhD candidates with their application. Molecular biology is revolutionizing the field of entomology at the individual animal level as well as at the population level (*i.e.*, ecology), and yet the facilities and staff competence in this area is weak.
- To develop a strategy to attain a better gender balance in Entomology.
- To continue the already quite successful efforts for increasing the quality of peer-refereed papers.

4.3 Forest Ecology and Management

Research Group:	Forest Ecology and Management (FEM)
Leader research group:	Prof. Frits Mohren
2014 Research input tenured staff:	3.0 FTE (9)
Score Research quality	1
Relevance to society	1
Viability	1

Motivations for scores:

Research quality

The group is ambitious with a clear direction. It continues to produce excellent research output, with a third of its papers being in the top 10% of most cited papers and 8% in the top 1%. We were especially impressed by the update of the research record that was given to us in the presentation. It demonstrated an extremely good output for 2015 with papers published or coming out soon in: *Nature* (1 or 2), *Nature Geosciences* (1), *Nature Communications* (1), *Science* (1) and *PNAS* (3). Much of the work is cutting-edge, topical, and driven mostly by intellectual curiosity. The group has excellent research links in Europe and beyond, as a result of a long track record in the European forest research arena. It collaborates and generously shares its resources: for example it is making available the results of a large range of permanent historical growth and yield plots, for use by the science community. The excellent profile of published output springs from choosing highly topical and 'big' research questions, covering tropical and temperate forests and touching also on policy and management. Such topics include the link between biodiversity and carbon storage, and the response of tropical trees to climate change. In part, this last topic is possible as a result of the group's bold decision a few years ago to establish a tree-ring laboratory (dendrolab) with the special capability of working on tropical trees. Previously, it had been thought that the growth rings of tropical trees were not sufficiently distinct for study. The group also has experimental capability revolving around forest test sites and there is strong emphasis on modeling tools and datasets.

Relevance to society

The group works on an extensive range of society-related activities, which are well-documented in their own report. Almost all of their research and teaching is relevant to society. As well as teaching and supervising forestry students, they carry out additional training where appropriate. They recently provided, for example, PhD and MSc training for a large group of Ethiopian researchers. Much of their society-related activities are local to the Netherlands: for example, their work on insect pests for The Netherlands Food and Consumer Product Safety Authority and their production of a text-book on forest management which is already in use in the Netherlands and Belgium. Emphasis is on training but also on international collaboration and informing policy and there is significant and active engagement in forestry issues. Staff are also active in numerous societal groups and provide a wide range of relevant advice.

Viability

There are some concerns relating to the age structure of the group, and the low number of postdocs and professors in relation to the large number of PhD candidates. However, we are confident that recent developments will ease the situation. These developments include: two associate professors being awarded personal professorships (Poorter, Zuidema), two external special professors arriving to strengthen the group (Nabuurs, Kramer), two assistant professors becoming associate professors (Peña-Claros, Sterck) and Peña-Claros was

upgraded to a permanent position. Also, the establishment of the dendrolab will continue to attract talented researchers as visitors. Time constraints are considered to be a challenge to future activities. Funding also needs to increase in order to maintain and enhance PhD levels.

Other remarks

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Recommendations

- The group appears to be functioning in an optimal manner, and no urgent changes are required. It should continue to pursue intellectually-driven research, and to further develop its strategy for high-profile publications.
- If possible, the book on forest management should be updated to cover Europe-wide forests and woodlands and be translated into English. It may become highly influential and it may strengthen the reputation of the graduate school.
- In the longer term the group is expected to continue to grow and expand its influence, which is currently substantial. In doing this, it should consider more collaboration with other PE&RC groups, where relevant facilities and know-how are already in place.

4.4 Farming Systems Ecology

Research Group:	Farming Systems Ecology (FSE)
Leader research group:	Prof. Pablo Tittone
2014 Research input tenured staff:	2.0 FTE (5)
Score	
Research quality	2
Relevance to society	1
Viability	2

Motivations for scores:

Research quality

The chair group Farming Systems Ecology aims to combine social-ecological insights and an understanding of the entire scale of farming decision-making in temperate and tropical regions with systems analysis to design sustainable agro-ecosystems in multifunctional landscapes. The group has successfully shifted their research focus from organic farming systems to the design and testing of multifunctional farming systems as part of alternative landscape configurations, as recommended by the 2009 review. Their success in improving the quality of publications is dramatic, especially given the short time since the appointment of a new Chair in 2012, as evidenced by the increase of RI from 1.16 in 2008 to 3.75 in 2013, with two T1 publications in 2013. The group is clearly on the path to becoming a world leader in this field if they are able maintain their output. Group members are well recognized, with multiple NWO grants and several important keynote lectures. They have established a large and strong network of collaborators for co-innovation research that presents a key infrastructure for their future research.

Relevance to society

The chair group is collaborating actively with scientific and private sector partners as well as development, lobby and policy organizations, and this has led to high media exposure. Major contributions include: co-innovation processes that have been adopted by national ministries; consulting in agenda development of international programs and NGO's in the development sector; decision-support for stakeholders in multifunctional landscapes that are being applied in the Netherlands and internationally; and the provision of model / software tools and training for implementation in development projects. The direct impact of this research is reflected by funding through competitive grants (e.g., EU) and contracts with international organizations (e.g., CGIAR), as well as consultancy (e.g., FAO, European commission, Bill & Melinda Gates Foundation).

Viability

The appointment of the current chair holder was a great success, acting as a catalyst to combine a PE&RC background and international experience with dynamic leadership in the three years since his appointment. The impressive increase in performance in the group therefore represents a successful group process facilitated by the ability of their leader to unite the group behind a vision and to sell that vision to stakeholders and sponsors. As a group, FSE has completely implemented the suggested change in focus and is now on the way to becoming a world leader in co-innovation of farming systems especially in developing countries. The score represents the current uncertainty for the group, given the unknown view of WUR with respect to a possible replacement chair.

This is a research field that is in high demand and the group has quickly acquired a strong reputation among relevant organizations with an effective and extensive network of local stakeholders in their priority countries. The appointment of the current chair holder to a leading position in Argentina ensures a productive ongoing collaboration that, together with

other projects that are already underway, will carry the group through a transition to a replacement of the chair holder.

Other remarks

The tenured staff is exclusively male, which should be corrected e.g. through future appointments to tenure-track positions.

Recommendations

- To decide and communicate as soon as possible, how the current chair holder will be replaced. This should include a confirmation of the proposed special professor appointment of the current chair holder. The group is well equipped to function with an internal interim chair holder for the interim period.
- To take steps for minimizing inheritance of any legacies (debt, personnel) by the successor of the chair holder.
- To increase integration with related chair groups (PPS, CSA). While there are important links and some methodological overlap with other chair groups within PE&RC, FSE has a unique capability to bridge the full range from biological processes to co-innovation with local farmers. FSE is viable as an independent chair group, but could also profit from integration. Alternatively, a new FSE chair holder could be appointed as part of a two-chair group to promote integration while maintaining the promising vision and approach. The committee does not recommend that the group be merged without a chair representation.

4.5 Farm Technology

Research Group: Farm Technology (FTE)
Leader research group: Profs. Eldert van Henten & Peter Groot Koerkamp
2014 Research input tenured staff: 1.4 FTE (6)

Score	Research quality	2
	Relevance to society	2
	Viability	2

Motivations for scores:

Research quality

This group has had a goal-oriented approach to raising research quality in terms of publications. While this has been quite successful, it should be continued to reach the output level of comparable groups in the domain. Based on the Relative Impact of the group from 2007 to 2012, as obtained from Web of Science (WoS) and SciVal, the group has been ranked among the 5 best comparable groups in the world. However, due to the focus on application oriented research, the average number of citations per publication is rather low. Moreover, the fields of research of both full professors are quite narrow, and the score is a result of this limitation. They approach the domain of Biosystems Engineering through two research lines: 1) system design, and 2) sensing, modelling and operation. The focus is more on sensing and analysis than on modelling. The farm technology group uses this generic approach to meet the complexity and diversity of biosystems as scientific challenges.

Relevance to society

The group performs high quality scientific research with societal impact. This is done based on in-depth analyses required by the longer-term demands of industry, government, and societal groups for sustainable development of production systems, and the group's strong cooperation with industry and the DLO research organization. Patents are not a primary aim of this group. Technologies for farming, which meet the changing needs of the society, are now being mandated by different societal groups, among which farmers, industry, politicians, and NGO's are included. The group could play a more active role in this through more intense cooperation with the stakeholders.

Viability

The group is small and would like to expand. With the recently appointed tenure-track positions, the group is well prepared for the future, and now has the flexibility to adapt to a changing environment in society and funding of research. The fact that there are no women among the tenured staff in this group adversely affect viability.

Other remarks

The committee considers the goal of becoming a 'small MIT of agriculture' as very ambitious. It was, however, not clear from the self-assessment report which strategy the group will follow to reach this goal.

Recommendations

- To develop a strategy for communicating the group's mission to society at-large and for increasing the group's visibility.
- To elaborate a clear strategy for further growth in depth and width. It is recommended to increase the basic research on generic principles in well-chosen focus domains.
- To develop a plan for addressing gender imbalance.

- To exploit cooperation with agro-industry.

4.6 Genetics

Research Group:	Genetics (GEN)
Leader research group:	Prof. Bas Zwaan
2014 Research input tenured staff:	3.0 FTE (9)
Score	
Research quality	1
Relevance to society	2
Viability	2

Motivations for scores:

Research quality

For a group of moderate size, GEN is outstanding in its productivity and reputation. The group contains several excellent scientists with strong publication records in peer-reviewed journals. There have been several changes in GEN since the last review, with a new Chair, and with the retirement of its most senior geneticist. The publication of research, and receipt of awards has been well maintained even as the group has shifted its focus to be based more on 'learning from evolution', and to consider more models in its studies of genetics. This allows the group to choose the 'right' model to address fundamental questions within three clear themes on (1) organization of heritable variation; (2) Genetics and levels of selection and (3) Genetics of adaptation. The group publishes at a high impact level and has received 6 major awards in the last 4 years, with the consequence that they are regarded as world-leading in genetics research across a broader range of species than any other group in the world. With regard to plants, a successful program in generating useful populations and innovative phenotyping has led to multiple insights into complex traits and GxE interactions. This and another example of examining yeast adaptation to heavy metals, is demonstrating how novel insights can be made from their structured research themes on model species, and that these can form the basis for application in commercial species.

Relevance to society

GEN has identified major societal stakeholders and is building relationships with them through teaching materials and work in ageing, for example, and through development of research linkages with companies working in genetics of fermented products and in plant breeding. These relationships are impressive, but will take more time to mature into strong societal impacts. The dynamic and diverse research environment of the GEN group is attracting large numbers of visiting scientists as well as new international collaborations. The expectation is that these relationships will in the short-term lead to the group making an outstanding contribution to international and national society. Students in GEN indicate that there are benefits to being part of a group that is in both plant-related graduate schools (PE&RC and EPS), partly because it exposes them to greater numbers of training ideas and opportunities. Industry is increasingly demanding graduates with high-quality training in quantitative skills, especially genetics, and students start to appreciate this early in their education from interactions with the MAT, BIO and PBR groups.

Viability

The GEN group is strong and dynamic with many new appointments, which distribute its capabilities, and teaching responsibilities across a large number of people. The group indicated that potential dependence on (expensive) technologies can be a weakness in this field, but is addressing this through collaborations with other groups in WUR, e.g. to develop phenotyping platforms. The GEN group has an ambitious strategy to develop its themes, and this certainly will require further development of current and future staff. While the group is well equipped for achieving these future roles, it will take time for them to improve its skills

and access to appropriate experimental facilities such as phenotyping. The GEN group already shares many PhDs in collaboration with other groups such as PBR and MAT, and it particularly needs to maintain these strong relationships with other groups. Viability in the future, as with many programs at WU, will depend on increasing resources. This is challenging in plant sciences as many other universities are active here, as well as several major corporations that invest heavily in revolutionizing crop traits based on fundamental advances in genetics. However, GEN's fundamental approach to genetics and heredity provides a strong basis for increasing its viability in all fields of genetics from plants through to applications in environment and health.

Other remarks

GEN has a bold vision, perhaps more so than most groups in PE&RC. However, they are well on the way to delivering ambitious impacts into diverse economic fields (plant and animal breeding, biocontrol, industrial production, and human health).

Recommendations

- Regarding plant science, delivery of GEN ideas into main-stream crop germplasm will be a major challenge. This will likely require extensive discussion and thinking about how to best facilitate collaboration with PBR (the main 'outward-facing' group) and potentially other research groups within and outside WUR, e.g. excellent research in CSL lines in Arabidopsis could be further confirmed in other plant models with groups who have CSL models for rice (CIRAD, France), for example.
- Phenotyping and its role in breeding is an exciting area of research for GEN, and in WUR is perhaps most developed in the HPP group. Opportunities exist for collaborations on novel traits and fields in other areas. Further increasing the number of joint PhDs, should facilitate synergistic collaborations. GEN can continue to look toward some of the well-established phenotyping groups in the European networks for innovative contributions to these areas.
- The committee endorses the 'fundamentals' approach of GEN and recommends that it continues to look for innovations in diverse areas where genetics can impact on health, environment and food production.

4.7 Geo-information Science & Remote Sensing

Research Group: Geo-information Science & Remote Sensing (GRS)
Leader research group: Profs. Arnold Bregt and Martin Herold
2014 Research input tenured staff: 3.6 FTE (9)

Score	Research quality	1
	Relevance to society	1
	Viability	2

Motivations for scores:

Research quality

The group has two chair leaders and combines aspects of remote sensing and geo-information to address key issues relating to sensing and measuring, modeling and visualization, land monitoring, human-space interactions and empowering communities. The majority of the research (~80 %) is agenda driven, with considerable impact coming from the application of the science rather than fundamental research (which reflects the funding streams). In the reporting period, there has been major investment (e.g., terrestrial laser scanners, unmanned airborne vehicles, spectral sensors) and substantive development of software and models (e.g., BFAST, GAOS, HILDA). The number of PhD candidates has increased (from 15 to 27) as did the postdoctoral research capacity. Publication has successfully refocused on higher impact journals and there has been a very good record (e.g., a good ranking in the top 10 % and top 1% of articles) with substantial increases in the number of articles published over previous years. There has been a strong drive to increase what is an already high level of funding which has been successful, although much of the funding is through contract research (EU, ESA) rather than from bodies supporting fundamental research. The group supports remote sensing using ground, airborne and spaceborne sensors operating in different modes and resolutions and they seem well equipped to utilize the big data arising from past (e.g., Landsat) and future sensors (e.g., Sentinels). The group has also internal interactions, which has resulted in remote sensing outputs being used with geo-information fields. This is regarded as one of the strengths of the chair-group.

Relevance to society

Strong collaboration within the research agenda has been facilitated by a high level of funding, which has often been interdisciplinary. A drive to inform policy at European and international levels has been a key focus and strength of the group. The group provides strong capacity building through PhD training, including within developing countries. Prof. dr. Herold plays a key role in leading programs such as GOF-C-GOLD and provides practical information and data allowing countries to fulfill international obligations (e.g., in relation to greenhouse gas accounting and REDD+ monitoring). Training materials have been developed and these have led to greater collaboration opportunities and funding. Numerous research products are of clear value to society and research is often undertaken in conjunction with Non-Governmental Organizations (NGOs), which help to raise the profile of the group and Wageningen UR as a whole. Spatial data-infrastructures have been used in drafting national geo-policy, with this considered to be a major contribution.

Viability

The group maintains a high funding reserve (stated as €800,000), which is available to reduce the impact of adverse changes in funding regimes. The increasing numbers of PhD candidates is also considered a measure of viability in the longer term, particularly if complimented by progression of postdocs and assistant professors into higher positions

(e.g., through the Tenure-Track). Budgets are viable with some fluctuations but are considered sufficient to support the activities of the group. The level and type of income is commensurate with the research outcomes being generated and has progressively increased over the reporting period. Teaching loads may be limiting research time but this was not considered to be a major issue given the assistance from PhD candidates and postdoctoral staff. Facilities (hardware and software) are available for handling big data and field equipment is also maintained, although there was concern that these might become obsolete because of advances in technology and other funds might therefore be sought. The long-term viability of holding a surplus therefore needs to be addressed.

The group has 6-weekly board meetings in which key issues are discussed and decisions made; excellent management of the group was conveyed. Staffing was not considered to be problematic as all researchers are in early to mid-career and new staff are coming on board (e.g., a Special Chair from CIFOR). The group needs to prepare for the significant changes that are likely to arise from new geo-information and remote sensing technologies and this may involve recruitment of new staff.

Other remarks

The group appears to work cohesively and there is interaction between the two main research areas of the group leads. This level of interaction is beneficial and should be encouraged.

Recommendations

- To make contributions to the highest-ranking journals (e.g., Nature, Science) whenever the research is of sufficient interest. Directing research towards publication in these journals should be considered.
- To provide a greater contribution to the fundamental research fields as opposed to applications, but the latter agenda should be maintained.
- To evaluate the future expenditure (e.g., on equipment) for ensuring that the facilities are adequately maintained or expanded, particularly given the significant advances in technology and computing systems.
- To plan ahead for the large amount of remote sensing and other data that are anticipated to become available within future years.
- To focus on obtaining resources from organizations focused on fundamental research as long as this improves upon and directly supports the research agendas of the group.

4.8 Horticulture and Product Physiology

Research Group:	Horticulture and Product Physiology (HPP)
Leader research group:	Prof. Leo Marcelis
2014 Research input tenured staff:	2.5 FTE (7)
Score	
Research quality	1
Relevance to society	2
Viability	1

Motivations for scores:

Research quality

The Horticulture and Product Physiology (HPP) chair group is one of the few most influential research groups in the world in its particular field. Its mission is to provide the scientific foundation for sustainable crop production and high product quality in horticulture. The themes in pre-harvest physiology (photosynthesis and morphogenesis) and post-harvest quality provide focus for the group, while the combination of experimentation and process-based modelling gives them a unique position in academic horticultural research worldwide. While a new Chair has been in place since Dec 2013, the group has significantly improved their numbers of citations since the previous review. It publishes on average 20 peer-reviewed articles per year in journals covered by Web of Science. The relative impact of the HPP publications is 1.95, which is above the world average impact and especially reflects their strong leading reputation in the field of the role of light to physiology and morphology. Recent awards have been impressive with students winning the national award for best thesis in plant science and the international Fame lab. Together with other groups (6 in all), especially MAT and GEN, HPP have demonstrated leadership in areas related to the analysis and interpretation of complex traits, including innovative research that spans genomics, metabolomics, experimentation and simulation modeling. Innovations with the CSA group development of new Functional Structural Plant Models in three horticultural crops, and demonstrate some of the leading opportunities in this area.

Relevance to society

HPP provides a very good contribution to society. The group is the only academic unit focused on horticulture in the Netherlands, but is strongly focused on the greenhouse industry as some components (like outdoor flowers) are covered by other groups in the Experimental Plant Science school. The group's focus has resulted in a very close relationship with the industry and national interests, but the group retains independence by ensuring that contracts are non-exclusive. Of particular importance, HPP has developed a concept how to reduce the use of energy in greenhouse horticulture by 50% if LED light is used in a smart way. They have been highly prolific in publishing the research, with more than 212 publications in professional horticultural journals during the current review period. Leadership in post-harvest research is also high-profile, with strong connections to industry in both greenhouse and tropical fruits, for example, which are shipped and ripened via the Netherlands. The research also attracts a considerable degree of attention from the general public, as indicated by contributions to general newspapers, radio and TV programs. Many projects are conducted with participation from companies. One example is the STW program LED with 10 companies.

Viability

HPP expects to increase the size of its group over the coming years, which will enlarge the critical mass. In particular the number of PhDs and postdocs is expected to increase, as at least 8 new PhDs and postdocs will start in 2015. HPP also plans to appoint a special

professor on product quality which will certainly expand the opportunities for new research areas, particularly to consider opportunities to modify quality through genetic and agronomic practices. The group's goal is to maintain its strong leadership position in the Netherlands and globally. Through internal cooperation with CSA, MAT and GEN, they plan to increase their capacity in phenotyping and modeling, paying attention to opportunities to utilize models to inform the basis for complex traits and improve the development of novel solutions to increase yield, production efficiency and quality. HPP are one of the prolific collaborating groups in WUR, and the value of these collaborations is clearly apparent in a diversity of high quality research and training that remains true and relevant to industry needs and national priorities.

Other remarks

The issue of gender balance in the academic staffing of the group, with one female among nine tenured staff and postdocs, is a matter that must achieve increasing emphasis in the future. The committee sees an urgent need to address this issue as soon as possible.

Recommendations

- To pursue a strategy that broadens the research focus in horticulture with increasing group size as opportunities arise, but to maintain the discipline within their current research themes.
- To develop strategies for increasing skills in combining phenotyping with modelling. Phenotyping facilities are being developed by groups outside WUR, and also as part of production monitoring in industry and these may provide some lower-cost but high-quality research capabilities as might remote-sensing methods (see FEM, GRS). Similarly, access to useful inference populations for these types of production and quality traits may need to happen through industry, unless PBR can take a specific interest to assist in developing relevant germplasm.

4.9 Mathematics and Statistics

Research Group:	Mathematics and Statistics (MAT)
Leader research group:	Profs. Jaap Molenaar and Fred van Eeuwijk
2014 Research input tenured staff:	2.6 FTE (11)
Score Research quality	1
Relevance to society	1
Viability	2

Motivations for scores:

Research quality

The MAT group is one of the few most influential research groups in the world in its particular field. It has expanded and developed since the last review, when it was still defining its position following the creation of the two chairs and the integration of DLO. Despite this expansion, the group has commendably reduced the number of topics and developed more focus in its research. The group's research per se or via collaboration in statistical genetics and systems biology is regarded as being world-class compared to similar research groups elsewhere. The group has increased their publication impacts while maintaining a sensible targeting of research toward relevant genetics and breeding journals which supports their delivery of outcomes. The high level of teaching provides teaching stream positions that indirectly assist delivery of the research.

Measurement of publication performance in MAT is difficult as math/stat publications in biology are relatively under-cited compared to other topics, and 31% of Q1 articles being in T10 can be regarded as high impact in this field. However, the group is increasing its outputs in the 3rd research area ('systems biology') and should be able to leverage this experience into the proposed 'big data' theme. This is an exciting initiative of the group and will complement efforts of other groups in ecology, agriculture and in plant breeding that are greatly increasing the number and types of observations being made through high-throughput phenotyping and genotyping. Examples include the 'Green Greenhouse' project to monitor large numbers of sensors, and the 'citizen science' research that is contributing to 'eco-informatics' such as tracking butterfly species.

Relevance to society

The Chairs are the catalysts that attract a large amount of contract funding and high-profile funding from national and international agencies. MAT has perhaps the most critical role in WUR in terms of training, as they provide training for every undergraduate student. During interviews, other groups indicated that MAT courses were well-tailored for both undergraduate and PhD candidates with specific initiatives to support different areas of need from ecology through to genomics and breeding. PhD candidates are almost always shared with other groups, but a unique aspect of MAT is that it often leads large projects in collaboration with others, whereas many other statistical groups take a secondary role in projects. This is clear recognition that the senior staff of MAT has sufficiently strong domain expertise to lead high-profile projects that can drive new statistical and mathematical solutions.

The Chairs are largely responsible for much of the direction of the Biometris group (WUR + DLO), and with MAT being a key WUR collaborator with commercial breeding programs in Europe in project delivery and in providing training programs for quantitative genetics and breeding. Biometris provides the software development for CANOCO (perhaps the world's most recognized multivariate software) and key components of GenStat (a leading commercial statistical software for biology and breeding), as well as developing open-source solutions in development projects supported by the Bill and Melinda Gates Foundation, for

example. These outputs and roles are evidence of its strong relevance to society in the Netherlands and globally through training and software delivery.

Viability

The group recognizes a need for undergraduates to develop much better data-mining skills and that there is likely a need to broaden their expertise in systems biology, data mining and possibly connections into ecology. While this recognition is clear, the group does not yet have a complete succession plan in place. In response to large demands, the group has appointed several new tenure-tracks, a program, and additional teachers.

Other remarks

None

Recommendations

- To proceed with 'big data' plans to deploy data mining methodologies more strongly into biology experimentation.
- To deliver on 'big data' research, the group will likely need to develop stronger links within and outside WUR to access these types of questions in biology , e.g. statistical modelling in time and space both in planned experiments and ecological studies.
- To rapidly develop a longer-term staffing plan, as three of the four main professors are approaching retirement.

4.10 Nature Conservation & Plant Ecology

Research Group:	Nature Conservation & Plant Ecology (NCP)
Leader research group:	Prof. Frank Berendse
2014 Research input tenured staff:	2.3 FTE (8)
Score	
Research quality	1
Relevance to society	1
Viability	1

Motivations for scores:

Research quality

The group provides themed interdisciplinary research with clearly defined goals and a wide breadth of topics. Avenues of new research are being followed (e.g., relating to the below ground components of biodiversity, genetic adaptation). Research quality and quantity measured by published output in peer-reviewed journals is extremely high. There are papers in: *Nature* (5), *Nature Climate Change* (1), *Nature Communications* (1), *Science* (2) and *PNAS* (3). Six of these papers have been published since 2009. In addition, five papers were highlighted in editorials in *Nature* and *Science*, reflecting the fact that selected research topics have been timely and with the highest possible impact. Of all the papers, 31% belonged to the top 10 % of most cited papers in the general field, and 5% belonged to the top 1%. The research is usually driven by intellectual curiosity. One theme, for example, addresses the long-standing problem of the connection between ecosystem bio-diversity and the capacity of the ecosystem to resist change and to deliver services. International research collaboration is excellent and the group continues to attract high caliber PhD candidates. The levels of funding to support the diversity of research are high, with grant income being about 20 % of the total. The group has benefited from strong leadership and functioning in an optimal manner.

Relevance to society

The group provides services to the Netherlands as well as to the University. Almost all the published research has a high societal relevance, either directly or indirectly, with much of this translated into effective strategies for conservation and restoration. Significant findings are taken through to inform policy at national and international level with some significant impact studies undertaken. For example, Berendse and Kleijn demonstrated that the benefits of nature conservation contracts with farmers were quite negligible and in some cases even negative (*Nature* 2001). Being extremely controversial, this publication resulted in subsequent papers and made the headlines in the media worldwide (BBC, *Financial Times*, *US Today*, *Frankfurter Allgemeine Zeitung*). The chair holder discussed these results with three successive Ministers of Agriculture. There has also been significant publication of professional papers and products and substantial recognition has been received in terms of contributions to society.

Veenendaal instigated public-private partnerships with the international companies NAM and Philips in a large project on the biological impacts of artificial street lighting. Another recent study with a high societal impact clearly demonstrated persistent negative effects of pesticide use on biodiversity and biological control potential on European farmland. In all three cases, the impact of the research has influenced government thinking. Moreover, such research findings feed naturally into the education program for BSc, MSc and PhD students, not only training the students but also inspiring them.

There have also been activities that directly engage with the Dutch public: a book about

nature conservation in the Netherlands, and an App for mobile phones.

Viability

An excellent new chair holder has been appointed to follow the retirement of the current chair holder. Three tenured staff members have retired but these positions have now been refilled with young researchers who bring new expertise in the group. It is expected that the new interests will attract funding and ensure vigor of the group in the coming decades. It is likely that student demand for training in this area will remain high, opening up the prospect of increasing staff levels. The breadth of research may limit focus within the group and consideration should be given to this. The development of new research facilities (e.g., the molecular laboratory) is anticipated to lead to further activities that will strengthen the group.

Other remarks

The NCP group has the ambition to initiate and lead a new Wageningen Centre for Nature Conservation. The mission of this center would be to

- build a framework for nature conservation firmly rooted in fundamental ecology,
- provide solutions for the most urgent practical management issues,
- take the lead in national debates regarding biodiversity and nature conservation.

The ambition is laudable and feasible. Membership of professional bodies could be increased.

Recommendations

- To consider growth in staff numbers after adjustment to new leadership and to a somewhat different research agenda (two years perhaps).
- To continue to pursue intellectually-driven research, and to develop further its strategy for high-profile publications.
- To further develop the new line of work on molecular genomics in the soil. This line represents a new and exciting area, which must be nurtured to address some of the classical unsolved problems in ecology.

4.11 Nematology

Research Group:	Nematology (NEM)
Leader research group:	Prof. Jaap Bakker
2014 Research input tenured staff:	2.5 FTE (7)
Score Research quality	1
Relevance to society	1
Viability	1

Motivations for scores:

Research quality

NEM is innovative, ambitious, clearly directed and performs exceptionally well. Worldwide it ranks among the top groups in the field of basic and applied nematology. NEM aims at understanding and predicting (!) the functioning of roundworms in cultivated and natural systems and approaches this ambitious objective by addressing two major fields: (a) molecular events of plant host manipulation by parasitic nematodes, and (b) role of soil nematodes in multitrophic interactions. The laboratory of nematology thus is on a particularly successful way for merging the much too often desperate fields of phytopathology and biodiversity, molecular approaches and ecology as well as microbial ecology and soil biology. A particularly outstanding result of these transdisciplinary activities is the development of a method that allows for phylogenetic and community analyses of nematodes based on small subunit rDNA. Ground-breaking achievements at the level of the two individual research fields include research on secretory proteins to unravel plant-nematode interactions or the impact of plant sensitivity to pests and pathogens on the range expansion by invasive species. This prolific group continues to expand its international scientific reputation by approaching new research areas, adopting up-to-date techniques and proactively addressing future challenges (e.g. big data).

NEM continues to publish in much respected high ranking journals with strong impact in a wide variety of disciplines. A clear strategy for streamlining publication efforts allowed for overcoming a problem detected by the previous assessment panel: the reduction of bibliometric indices by publishing in specialized journals. This strategy led to a remarkable high average RI of 3.32 and to a high share of publications in T10 and T1 journals. The group has excellent research links (in Europe and beyond) and received numerous highly competitive grants (e.g. ERC-advanced grant). The NEM research agenda makes it possible to approach cutting edge research questions and to address topics that are of enormous interest for stakeholder such as vegetable and tomato breeders or soil testing companies. The group holds several patents.

Relevance to society

All research fields addressed by NEM are of enormous societal relevance - from the local to the global scale. Outstanding topics range from DNA barcoding assays for identifying/quantifying nematode species that are used by private and governmental labs to the breeding of nematode resistant cultivars and quantitative approaches to the impact that free-living nematodes have on soil health, ecosystem functioning and ecological services. NEM very effectively outreaches to the society by excellently communicates focal areas to a broad range of groups. A very good example are the mobile DNA courses on marker-assisted breeding and GM crops, by which NEM has already reached more than 140,000 high school students. Where appropriate, the group provides training (e.g. workshops, e-Learning) to companies and policymakers. Moreover, NEM shows direct public engagement

by displaying worm-pathogen interactions at the MicroZoo in Artis and by organizing science for children workshops.

Viability

Though there are some concerns relating to the age structure of the group, NEM is very well equipped for the future by approaching vibrant scientific themes. The appointment of Wim van der Putten as endowed professor (NIOO) significantly contributes to the sustainability of the group by broadening the field of research. The group has decisive leadership and firm plans for the future, with the two program leader having successfully managed to combine a strong guidance with the development of a very good and productive team spirit. We are confident that the scientific objectives of NEM will uphold their relevance and innovative strength for decades. The scientific visions of NEM for meeting future challenges are outstanding. Four new staff members who might be developed into assistant professors together with two young assistant professors may act as catalysts for maintaining the long-term viability of NEM.

Other remarks

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Recommendations

- To make every effort for keeping NEM at the level it currently is.
- To invest more efforts in merging the fields of phytopathology and ecology in the light of the “One Health” concept. Considering the challenges provided by Global Change, this definitely is an important advice.
- To elevate public awareness and societal outreach of biodiversity and ecology to the level phytopathology already has.
- To intensify cooperation with other PE&RC groups.

4.12 Plant Breeding

Research Group:	Plant Breeding (PBR)
Leader research group:	Prof. Richard Visser
2014 Research input tenured staff:	8.1 FTE (21)
Score Research quality	2
Relevance to society	1
Viability	2

Motivations for scores:

Research quality

Compared with other groups, the PBR group is large with approximately 200 people including 21 scientists, 50 PhD and 35 MSc students. The research in the group is organized around 5 themes and 10 mixed groups. It is one of the only two groups that integrated fully personnel from Wageningen University and from DLO-PRI. The group works on a wide range of species and uses multiple populations that they developed, with most being reused over time. It is the only plant breeding group in the Netherlands at the university level and as such it has a strategic role for the development of innovative methods for plant breeding in multiple species (especially polyploids), even more than for the development of breeding and pre-breeding material. The committee was impressed by the quality of the research as reflected by a large number of publications that have on average an impact that is well above the international mean. This performance has increased substantially since the 2009 review, and compared against some of the leading international groups in plant breeding the group appears to be at their level using quantitative measurements such as the number of publications and their number of citations. The funding in the group is dominated by contract research but the committee believes that the group would benefit from greater access to competitive grants such as the Veni, Vidi, Vici or the ERC granting schemes in order to support more researchers in developing original research in novel aspects of plant breeding. The committee feels quite strongly that there should be a greater effort in the group on frontier research in plant breeding especially in central themes such as elucidating the architecture of complex traits and GxE and developing novel approaches for the identification of genes underlying such traits, *i.e.* the group should take a leading role in developing novel types of populations (CSL, NAM, MAGIC, where relevant) to complement their largely 'QTL-based' breeding studies and solutions.

Relevance to society

The Plant Breeding group has a great societal impact that stems from multiple activities carried out such as the organization of courses for breeding companies and developing countries, the licensing of IPRs on pre-breeding materials, the strong partnerships with companies, the strong and dedicated effort in undergraduate and graduate education and the active involvement in the societal discussion on cisgenesis and new plant breeding methods and software. The group provides comprehensive training in different crops and topics which also accommodates specific needs of sandwich PhDs. New bi-lateral arrangements (*e.g.* China, Korea, Chile, Ecuador), and new courses (summer schools and distance leading modules) benefit early and mid-career breeders.

Viability

The chair group is on a well-established and defined path that will ensure a bright future through the extension of currently carried out research activities and projects. The committee, however, has concerns on the ability of the group to move into new research areas partly as a consequence of the great success in the current activities. The advent of

the genome editing technologies (e.g. the CRISPr/CAS technique) that could effectively replace current mutagenesis methods shifts focus to the identification of targets for editing, *i.e.* on the identification of genes and nucleotides that affect traits of agronomic relevance. This requires greater effort and collaboration in the development of novel methods, populations and phenotyping to accelerate trait dissection and gene identification. While the group expressed intent to develop high-throughput field phenotyping research, no evidence was given that this is yet happening, and the group has little active research around ‘targeting’ of breeding and exploitation of GxE as part of marker-based or genomic prediction based breeding.

The group listed as a threat that “more groups are shifting to crops and plant breeding research” and indicated concerns about sharing populations and data which could be used competitively against them. This is indicative of a need (perhaps mediated by the School) for improved mechanisms to strengthen links between PBR and the mathematical groups (Bioinformatics and Mathematics and Statistics) as well as with CSA for abiotic adaptation, and the ENT, NEM and VIR groups for biotic stresses. While PBR would often seem to be the obvious lead in such work, this will not always be the case. Some concerns do persist on the effective merging of the University and the DLO groups especially when it comes to the administrative aspects even though the efforts performed so far have been very successful in integrating the research efforts of the two groups.

Other remarks

Recommendations

- To invest more into novel research areas and population development especially through the active involvement, and possibly recruitment, of young scientists of the group into these activities in order to spread research expertise beyond the successful professor positions.
- To improve research collaborations in data and germplasm to the benefit of WUR as a whole. Given its important industry role, innovation in genetics, phenotyping and breeding in multiple crops depends on PBR being a leading but not dominating collaborator.

4.13 Plant Production Systems

Research Group:	Plant Production Systems (PPS)
Leader research group:	Prof. Ken Giller
Research input tenured staff:	2.8 FTE (9)
Score	
Research quality	1
Relevance to society	1
Viability	1

Motivations for scores:

Research quality

Research impact of the group has increased substantially since 2009, with greater attention on issues of global food production and a focus towards Africa. The research spans a range of scales: field, farm, region and globe. At the farm scale, there are field observations and experiments, asking questions about what limits crop production, whilst at the larger (regional and global) scales the research questions relate to issues of sustainability, policy and climate change. This work involves international collaboration, and the group has been active in establishing and nurturing a global network. One aspect of the work is modelling, which is significant, although it is difficult to apply classical mechanistic models to the real situation in sub-Saharan Africa where rate-limiting factors are not always well-established.

Overall, the work takes place under the banner of 'closing the yield gap', and this high profile stance has helped to secure substantial funding (e.g., from the Bill and Melinda Gates Foundation) which will no doubt bear fruit as high-profile papers in years to come. Not all the work of the group has an African focus of course; much excellent work relating to land use in the Netherlands and more generally in Europe and Asia (China, Indonesia) is in progress. We note the aspiration 'to sustain research foci in both developing and developed regions. To this end, we are involved in several EU Horizon 2020 proposals'. The current published output is strong but perhaps not as strong as it might be considering the importance of the work to global food security and to the global economy. The research continues to be interdisciplinary and there is strong collaboration with groups at WUR (e.g., within WaCASA) as well as nationally and internationally. The group addresses the need for expertise in key areas of agriculture research arising from competing demands for development and requirements for science orientation.

Relevance to society

Because it deals with food production and environment, the group's work is inherently important to society and there is a wide breadth of outreach. The group makes a genuine effort to disseminate its work to professionals and to the general public, with significant attendance at public meetings and conferences. There is a good media presence. Key studies relating to food security have resulted in advice and publications (e.g., as books and an atlas) and the group has been active in alerting governments. At the professional level, there is, for example, an open library of data and models <http://models.pps.wur.nl/models>. For project members and NGOs, there is the N2Africa Podcaster, which provides a regular newsletter that shows the reality of fieldwork in village communities of sub-Saharan Africa. Meanwhile, for the general public in the Netherlands, there have been many communications through radio, TV and newspapers, and outreach to many groups including schools.

Viability

A large and vibrant group has been created by excellent leadership; there is a very good gender and ethnic mix and an evident 'team spirit' with support between members. There are two full Professors, 1 Associate Professor, 5 Assistant Professors, 5 post-doctoral

researchers and three technical staff. The group attracts a large cohort of Visiting Fellows, as many as 19 during the review period. The capacity to attract major funding has never been in doubt; a relatively small amount (2-10 %) is from sources addressing fundamental research. The large grant from the Gates Foundation has positioned the group very strongly in Europe, and they may expect to be especially successful in their applications to the European Commission and elsewhere.

Other remarks

The relationship between members of this group seem to be based on principles of respect and mutual support, and not based on hierarchy. Leadership is sensitive to the needs of individual researchers. In the group's own words: 'the core of our strategy and culture is focus on teamwork and maintaining a collegial and enjoyable work atmosphere'. There is some concern about workload (including teaching) and support, staff retention and maintaining software.

Recommendations

- To improve the quantity and quality of published output, targeting high-profile journals with high impact papers, especially in collaboration with internationally renowned partners.
- To continue publishing the results of specific studies carried out by PhD candidates, enabling them to launch their careers.
- To review the level of administrative support in view of the high level of activity in this group.

4.14 Resource Ecology

Research Group:	Resource Ecology (REG)
Leader research group:	Prof. Herbert Prins
Research input tenured staff:	3.4 FTE (11)
Score	
Research quality	1
Relevance to society	1
Viability	2

Motivations for scores:

Research quality

The REG has a strong position amongst the research groups at WUR and their research funding is driven by their scientific direction. The scientific standing is among the top groups worldwide. Publications are in top journals (e.g., Nature Climate Change, Science) and there has been a strong focus on journal article production, particularly in Q1. The presence of their work in the top 1 % and 10 % of publications reflects their success. There is excellent access to research facilities, including those in other countries and the outcomes of their research are leading to practical applications in many fields (e.g., based on influence of type and numbers of animals on vegetation and ecosystems). The group is recognized internationally in target areas and the staff are undertaking high quality research as reflected by their strong bibliometric performance, metrics of individual staff, PhD candidate recruitment and research income. International collaboration is high. The group justified the transition of their research towards Disease Ecology (away from Wildlife Ecology because more difficult to achieve excellence) whilst still maintaining focus on Resilience and Climate Variability, Movement Ecology and Animal Ecology. This transition seems to have been successful, including in relation to numbers of papers, grants and PhD projects. For example, 12 PhD positions have been approved and financed by China (six will defend their theses at WU) and there is also a new course planned on disease ecology.

The only area of concern was the limited number of postdocs, although the PhD community is strong (22 currently enrolled) and duration rates (average 4.2 years) are good. The group has also been more successful in winning 'contract' rather than fundamental research grants but have achieved a high level of scientific outputs with the funding provided.

Relevance to society

There are strong linkages with conservation organizations worldwide with emphasis on science-based decision-making (e.g., in relation to avian influenza). There is demonstrated uptake of scientific outputs and advice, an impressive record in public dissemination activities (including film and radio) and clear commitment and achievement in equipping people with the skills to undertake research, education and management around the world. Strategic interdisciplinary development is also occurring through the National One Health Centre, which is leading to greater funding and collaboration with other organizations (e.g., Utrecht Veterinary Sciences).

Viability

The group has a high level of external funding, including from contractual research (e.g., Shell). Funding has been an issue and has limited some collaborations (e.g., with Africa) in the past but is continually being sought; it is considered sustainable. The group also runs attractive masters programs, with a sustainable number of candidates, and the PhD cohort is well balanced with academic staff (in terms of number). The teaching load is manageable. There is a clear progression from masters to PhDs, Postdocs and academic staff. The tenure

track system has also resulted in a larger amount of papers in the Q1 and Q2 categories, which count towards promotion, whereas some of the earlier appointed assistant professors have a weaker publication track record and have not moved up to associate professor level. Facilities (e.g., UniFarm) that are used by the group continue to be supported. Regular meetings are held to ensure success in teaching and research.

A key player is moving to another group and – independently of the collaboration between the two groups - the committee has concerns about the loss of expertise on biodiversity conservation and ecosystem services as well as about the possibility that some staff that are more associated with this work might find better placement within that group. Merging of the REG and NCP chair groups could be an option (as was already suggested on page 9 of this report).

Other remarks

The name of the group could be changed to, for example, Animal Ecology as they are now allowed to use this name.

Recommendations

- To increase the proportion of grants focusing on undertaking fundamental research.
- To put a succession strategy in place well in time before the anticipated retirement of the leader of the group, as this event is foreseen in the period that these recommendations are addressing.

4.15 Soil Geography and Landscape

Research Group:	Soil Geography and Landscape (SGL)
Leader research group:	Prof. Jakob Wallinga
Research input tenured staff:	2.8 FTE (10)
Score	
Research quality	2
Relevance to society	2
Viability	2

Motivations for scores:

Research quality

The Soil Geography and Landscape group aims to integrate biophysical and human elements to understand past, present and future system dynamics in order to support sustainable land management. Despite the loss of four key players, including the former chair holder, and the related drop in PhD candidates, the group has maintained their productivity and publication quality, which is high for the interdisciplinary nature of their research. Several group members have received prestigious research grants or awards, including VENI and NWO Rubicon grants. With the new luminescence lab at WUR, they are ideally positioned to spearhead innovative applications of soil luminescence dating. While the group is not yet one of the most influential internationally, they have the potential to get there. They already profit from strong interactions with other groups within the university and outside. The publication record is strong, but there has been a decline in journal article output in recent years, likely related to low staffing and a related dip in the number of PhDs. The high proportion of articles in T1 and T10 categories reflects the significance of the research that has been published (including in *Nature*). Funding for fundamental research has increased significantly over the past two years.

Relevance to society

The communication of the groups' successes to the wider community is achieved through models, data and software, publications, lectures and a good media presence. The group's contributions have changed from development of models like Lapsus and CLUE to supporting their application through co-production of knowledge (e.g., workshops with policy makers, stakeholder groups etc.). The tradeoff analysis model is used by various programs (e.g., Bill and Melinda Gates Foundation, CGIAR). Digital soil mapping methods developed by SGL are used by Alterra to produce a national soil map as legal reference for spatial planning. The Netherlands Centre for Luminescence dating brought to WUR by the new chair provides collaboration with several Netherlands research groups and services for external customers across a range of applications. The dating of a *Homo erectus* shell engraving led to a Nature paper and high international publicity. Contract research includes numerous EU projects as well as public/private partnerships and research-for-development projects. Whilst relevance to society was high, the communication of the diversity of outcomes through different media could be increased even further.

Viability

Successful transition of research lines has been followed by increasing integration of the main research topics, where the interdisciplinary combination of approaches allows the group to make unique contributions.

The group has been so successful that several members have been promoted away, including the chair holder. The score reflects this temporary weakening. The anticipated promotion of two members to personal professors will strengthen this dynamic group and allow them to increase the number of PhDs and to attract additional research grants,

particularly those supporting fundamental research. The group seems to be able to cope with their teaching load and they fully embrace their teaching role.

Other remarks

The group has suffered from the loss of staff but have maintained a good level of output, which is being enhanced through grant income. Publication rates and number of PhD's have suffered temporarily but there is likely to be an increase in future years based on the greater viability of the chair group. The timing of the present evaluation is a bit early following the chair replacement in Nov. 2012.

Recommendations

- To further increase research grant funding toward the group's target of 25% of the budget.
- To make sure that continued funding of the luminescence dating facility allows for maintaining the new and successful research direction.

4.16 Soil Biology & Biological Soil Quality

Research Group:	Soil Biology & Biological Soil Quality (SOQ)
Leader research group:	Prof. Lijbert Brussaard
2014 Research input tenured staff:	2.8 FTE (9)
Score Research quality	1
Relevance to society	1
Viability	2

Motivations for scores:

Research quality

SOQ definitely belongs to the most influential groups in the field of soil biology and biological soil quality. Carrying out its work under the banner of “living soil” the group maintained its three research themes that focus on basic and applied scientific fields of global significance: Fertile soils, soil biodiversity and climate change. Approaching innovative topics, including new research areas (e.g. microbial ecology, above-belowground interactions), intensifying cooperation (e.g. with the Soil chemistry group) and appointing very promising scientists allowed SOQ to further expand its international academic reputation and to achieve a very high productivity compared to its size.

A clear strategy for streamlining publication efforts by following the advice of the previous assessment panel lead to a substantial increase of the average RI from 1.55 (2002 – 2007) to 2.62 (2008 – 2013) and of the %T10 from 16.4 to 36. The group has decisive leadership and firm plans for the future. The group is intensively interacting with other PE&RC groups and its research agenda is able to easily be applied to many questions. It is successful in receiving funding for basic and applied research. Within this framework, the strategic PE&RC grant and the NWO grant strongly contributed to further increasing research quality. Stakeholder demands are being met and there seems to be a good claim for this.

Relevance to society

Soil biodiversity and functioning are of enormous importance for sustainable increase of food production, mitigation of climate effects, environmental health and ecosystem functioning. SOQ thus addresses topics that are of outstanding societal relevance from the local to the global scale. They do an excellent job in communicating their focal areas to a wide variety of target groups. A very good example for effectively disseminating information on the cryptic life in soil is the impressive YouTube movie on earthworms that even raises sympathy for the slimy beasts below our feet. The group was very successful in stimulating a public-scientific debate on earthworm effects with their paper in Nature Climate Change. Their ability to learn from the concerns raised in this debate is proven by their recent efforts to evaluate these issues in a more ecosystem-oriented approach. SOQ also very effectively participates in policy discussions and shows direct public engagement. This includes interactions with farmers, engagement in citizen science, scientific debates with an active student population as well as the involvement in “children universities”. Last but not least, the publication of books for the general public, the production of software tools and the regular involvement in internet based discussions raise the perception of societal relevance.

Viability

SOQ is very well equipped for the future. A chair with a strong leadership together with a team spirit that obviously is very good and productive allow for focusing on research topics that definitely will maintain their high relevance, visibility and innovative strength for the next decades. The visions of SOQ for meeting future scientific challenges are excellent. However, very much of the standing of SOQ depends on its current group leader, who will retire soon.

Moreover, the number of people involved in agenda setting seems to be comparatively small and the availability of scientists with taxonomic expertise for addressing essential biodiversity issues is declining worldwide. The group has undertaken considerable efforts for developing promising paths to the future by establishing links to other groups (e.g. to compensate for taxonomic deficits) and by employing promising young scientists. There is an urgent need to continue with this clear and resilient plan concerning the future composition of the group for pursuing the years ahead.

Other remarks

None

Recommendations

- To make even more use of complementing expertise available in other PE&RC groups, which address different areas of soil ecology and management. A promising field for doing so would be the development of a concise concept for the sustainable use of living soils over a wide range of spatial scales.
- To continue or even expand cooperation with groups focusing on socio-economy right from the start of research programs addressing ecosystem services provided by soils.
- To increase own initiative for filling the growing gap of knowledge regarding taxonomic expertise (e.g. offering/developing/participating (in) specific training courses). As a leading group in the field of soil biodiversity, SOQ has a considerable responsibility for doing so (in particular in relation to developing countries).
- To increase public awareness regarding the role of soil biodiversity by approaching even more schools (in particular teachers).
- To maintain the Relative Impact at a high level, as it was somewhat fluctuating over the past years.

4.17 Virology

Research Group:	Virology (VIR)
Leader research group:	Prof. Monique van Oers
2014 Research input tenured staff:	1.8 FTE (6)
Score	
Research quality	2
Relevance to society	2
Viability	2

Motivations for scores:

Research quality

This group has been under transformation with new appointments and the new leadership is fairly recent. The group has worked with establishing research directions and intends to concentrate efforts on 3 research lines, plant virology, invertebrate virology (primarily on viruses that kill insects or shrimp), and arbovirology (viruses transmitted by mosquitoes that cause disease in mammals). The primary focus is on using the basic knowledge of virus/host interactions with the aim being to prevent viral diseases. Other research deals with topics such as the use of baculovirus vectors for production of antigens used to generate vaccines for mammals, and understanding “virus mutualism” based on recent studies that show, for example, some plant viruses can be beneficial to plants by making them more tolerant to drought. Studies on the use of viruses to control lepidopteran pest populations, a major focus of this group in the past, is in decline, but still ongoing through collaborations with researchers in other countries, for example in Asia and Europe, where these viruses are still used to some extent in integrated pest control programs. Overall, the publication record has been good, especially considering the relatively small size of the group. Over the period 2009 – 2014, 19% of the publications in their field were in the top 10% of publications cited, and 3% in the top 1%. There is a good trend toward publication of papers in higher impact journals with a higher level of citations. Emeritus Professor J. Vlak adds to the group’s international profile owing to his previous research on baculoviruses, and his going collaborative work with researchers in other countries on viruses that attack shrimp in aquaculture, an important and growing food source in many countries. One particular challenge is that this relatively small group works in three different major areas of virus research, so it could be argued that they have spread themselves too thin. Also although the number of PhD candidates is acceptable, they need to have more post-doctoral fellows to enhance their research profile and assist with the teaching.

Relevance to society

Viral diseases of plants and animals are a serious threat to future health and welfare of the world’s food supply, as well as controlling mammalian diseases vectored by insects such as mosquitoes. Communication of the role of this group in this important area would be something to work on to raise the profile of the group (and possibly attract funding). Is there a communication strategy in place for this group? Considering the importance of controlling viral diseases to plant and animal health, the efforts of this group are rather minimal with respect to raising their societal profile. More attention should be paid to communicating to the public the relevance of their research to societal needs. This could well benefit their funding.

Viability

As noted above, this group has a lower number of postdoctoral researchers in comparison to other groups and thus, despite three out of five are/were from abroad, low international representation. The strategy for increasing the number of post-doctoral fellows and international representation is not clear. On the positive side, though a small group, it has

one of the best records in gender balance within PE&RC, and the only group among those we were charged with reviewing with a woman as the research leader. The new addition of V. I. D. Ros, who studies the manipulation of insect behavior by viruses adds strength to this program, as does the appointment of R. van der Vlugt as a special professor focusing on plant/virus ecology. Nevertheless, given the relatively small size of this group, the existing number of international collaborations must be a drain on resources from the standpoint of administration. This could have a negative impact on this group if it continues in the future. Related to this, there is a clear need to better leverage their resources.

It should be kept in mind that the leadership of this group became unstable over the current review period beginning with the tragic death of Prof. dr. R. Goldbach in 2009, subsequently replaced by Prof. dr. J. Vlak, as interim chair of virology. He realigned the research program and officially retired in 2012, but stayed in charge of the program until 2013. The appointment of Prof. M.M. van Oers in 2013 as Prof. Vlak's successor has added needed stability to this group, which should increase its future viability.

Other remarks

Compared to the other chair groups under assessment, Virology has more female professors, M. M. van Oers and V. I. D. Ros; the latter was awarded a VENI grant in 2011 and assistant professorship in 2015.

Recommendations

- To increase the number of post-doctoral fellows in the near future through internal and extramural funding to strengthen its viability.
- To reduce the numerous international collaborations. It is recommended to strengthen and perhaps expand only those that result in truly productive relationships.
- To better leverage Virology's resources by establishing stronger and new relationships with other groups in PE&RC and EPS, especially those involved with crop pests, plant and animal vector control, and large scale data analysis.

Annex 1 Criteria and scores of national protocol SEP

Criterion 1: Research quality

The committee assesses the quality of the chair group's research and the contribution that research makes to the body of scientific knowledge. The committee also assesses the scale of the chair group's research results (scientific publications, instruments and infrastructure developed by the group, and other contributions to science). The following elements are to be considered in assessing this criterion:

- scientific quality
- productivity to the scientific community (in relation to the volume of the tenured scientific staff)
- the academic reputation of the group
- the strategy to provide the output at the highest relevant level possible

Criterion 2: Relevance to society

The committee assesses the quality, scale and relevance of contributions targeting specific economic, social, or cultural target groups, of advisory reports for policy, of contributions to public debates, and so on. The point is to assess contributions in areas that the chair group has itself designated as target areas. The following elements are to be considered in assessing this criterion:

- a narrative in which the group demonstrates its relevance for society
- research products for societal target groups such as
 - professional publications and outreach to the general public
 - other research output to society
- use of research products by societal groups such as
 - patents, licenses, training courses
 - projects in cooperation with societal partners (European Union, Topsectoren, international funds)
 - contract research (including consultancies), also co-publications and use of facilities
 - present jobs of alumni
- demonstrable marks of recognition by societal groups such as demonstrated by
 - advisory reports for the government
 - media exposure as presentations on radio / TV, invited opinion articles etc.
 - membership societal advisory boards

Criterion 3: Viability

The committee assesses the strategy that the chair group intends to pursue in the years ahead and the extent to which it is capable of meeting its targets in research and society during this period. It also considers the governance and leadership skills of the chair group's management. The following elements are to be considered in assessing this criterion:

- leadership of the chair
- (scientific) visibility and recognition
- research vision and strength of the research lines
- innovative strength
- strategic choices and decisions
- composition of the group (expertise, people)
- acquisition capacity

The meaning of the scores for the three main assessment criteria:

Score	Meaning	Research quality	Relevance to society	Viability
1	Excellent / world leading	One of the few most influential research groups in the world in its particular field	An outstanding contribution to society	Excellently equipped for the future
2	Very good	Very good, internationally recognized research	A very good contribution to society	Very well equipped for the future
3	Good	Good research	Makes a good contribution to society	Makes responsible strategic decisions and is therefore well equipped for the future
4	Unsatisfactory	Does not achieve satisfactory results in its field	Does not make a satisfactory contribution to society	Not adequately equipped for the future

Annex 2 Programmed Site visit PE&RC Peer Review June 2 – 5

Monday June 1

17.30- 18.30 Meeting of Chair and Secretary to discuss scheduled program of site visit
19.00 Informal welcome dinner with PE&RC Board and office staff

Tuesday June 2

08.15 – 08.30 Opening by Ken Giller, chair PE&RC
08.30 – 09.00 Welcome and introduction by Dean of Sciences, Prof.dr Johan A.M. van Arendonk
09.00 – 09.30 Bibliometric Analysis (library) (Ellen Fest)
09.30 – 10.00 Introduction to the program and questions about the documentation
10.00 – 10.30 Tea/coffee break
10.30 – 11.30 Introduction to PE&RC
11.30 – 12.30 Discussion by panel on pre-assessments and internal procedures
12.30 – 13.30 Lunch Grand Café Forum building
13.30 – 14.30 Discussion by panel on pre-assessments and internal procedures (cont.)
14.30 – 14.45 Short break splitting into groups
14.45 – 15.45 Meeting with chair groups

Group 1: Soil Biology and Biological Soil Quality (SOQ)

Panel members: Volkmar Wolters, Barbara Ekbom, Brian Federici, Scott Chapman

Group 2: Soil Geography and Landscape (SGL)

Panel members: John Grace, Richard Lucas, Helen Wagner, Reiner Brunsch

15.45 – 16.15 Tea/coffee break and feedback session of review panel
16.15 – 17.15 Meeting with chair groups

Group 3: Resource Ecology Group (REG)

Panel members: Volkmar Wolters, Scott Chapman, Richard Lucas, Helen Wagner

Group 4: Farm Technology Group (FTE)

Panel members: Reiner Brunsch, Brian Federici, John Grace, Barbara Ekbom, Wouter Saeys (External member¹)

18.00 – 23.00 Dinner followed by writing draft reports and preparing scheduled interviews

Wednesday June 3

09.00 – 10.00 Meeting with chair groups

Group 5: Forest Ecology and Management (FEM)

Panel members: John Grace, Volkmar Wolters, Richard Lucas, Helen Wagner

Group 6: Crop Systems Analysis (CSA)

Panel members: Reiner Brunsch, Scott Chapman, Brian Federici, Barbara Ekbom

¹ There is limited panel expertise within the in the area of Farm Technology; therefore, in this specific case an extra member has been added

10.00 – 10.30 Tea/coffee break

10.30 – 11.30 Meeting with chair groups

Group 7: Nature Conservation and Plant Ecology (NCP)

Panel members: John Grace, Volkmar Wolters, Richard Lucas, Barbara Ekbom

Group 8: Farming Systems Ecology (FSE)

Panel members: Reiner Brunsch, Scott Chapman, Brian Federici, Helen Wagner

11.30 – 11.45 Short break

11.45 – 12.15 PE&RC postdoc policy

12.15 – 13.15 Lunch with postdocs

13.15 – 14.15 Meeting with chair groups

Group 9: Geo-Information Science and Remote Sensing (GRS)

Panel members: John Grace, Helen Wagner, Richard Lucas, Volkmar Wolters

Group 10: Horticulture and Product Physiology (HPP)

Panel members: Reiner Brunsch, Scott Chapman, Brian Federici, Barbara Ekbom

14.15 – 14.30 Short tea/coffee break

14.30: Meeting with Arian Steenbruggen of the Environmental Sciences Group (part of management team)

14.30 – 15.30 Meeting with chair groups

Group 11: Mathematics and Statistics

Panel members: John Grace, Scott Chapman, Helen Wagner, Barbara Ekbom

15.30 – 16.00 Tea/coffee break

16.00 – 16.45 PE&RC PhD program

16.45 – 17.30 Meeting with PE&RC PhD Candidates platform

18.30 Dinner with PhD candidates

21.00 – 23.00 Internal meeting committee to prepare scheduled interviews

Thursday June 4

08.30 – 09.30 Meeting with chair groups

Group 12: Plant Breeding² (PBR)

Panel members (together with EPS): Scott Chapman, Michele Morgante³, Dorothea Bartels³, Myron Zalucki³

Group 13: Virology² (VIR)

Panel members (together with EPS): Brian Federici, Barbara Ekbom, Ulla Bonas³, Natalia Dudareva³

Group 14: Plant Production Systems (PPS)

Panel members: John Grace, Reiner Brunsch, Volkmar Wolters, Richard Lucas, Helen Wagner

² Combined meeting of EPS (Graduate School Experimental Plant Sciences) and PE&RC panel members involved in assessment of joint EPS/PE&RC groups. The panel composition reflects the participation in both schools: Genetics, Virology, Entomology and Nematology are assessed by a panel of 4 people: 2 from the EPS panel and 2 from the PE&RC panel. Plant Breeding is assessed by 3 members from the EPS panel and 1 from the PE&RC panel.

³ From evaluation panel of EPS

09.30 – 10.00 Coffee/tea break

10.00 – 11.00 Meeting with chair groups

Group 15: Nematology² (NEM) (room W0.2)

Panel members (together with EPS): Volkmar Wolters, Scott Chapman, Ulla Bonas³, Dorothea Bartels³

Group 16: Entomology² (ENT)

Panel members (together with EPS): Brian Federici, Barbara Ekbohm, Myron Zalucki³, Natalia Dudareva³

Writing session (remaining panel members) (room W.07)

Panel members: Richard Lucas, Reiner Brunsch, John Grace, Helen Wagner

11.00 – 11.15 Short break

11.15 – 12.15 Meeting with chair groups

Group 17: Genetics² (GEN)

Panel members (together with EPS): Scott Chapman, Brian Federici, Michele Morgante³, Dorothea Bartels³

12.15 – 13.00 Concluding session EPS-PE&RC committee members (including lunch) (room W0.2)
Scott Chapman, Brian Federici, Barbara Ekbohm, Volkmar Wolters

12.15 – 13.00 Writing session (continued: remaining panel members; including lunch) (room W.07)
Richard Lucas, Reiner Brunsch, John Grace, Helen Wagner

13.00 – 14.00 Excursion to greenhouse experiments

15.30 Skype interview director general Plant Sciences Group: Ernst van den Ende

14.00 – 18.00 Concluding and writing session (room ATLAS 1)

19.00 – 23.00 Dinner followed by writing draft reports and preparing preliminary conclusions

Friday June 5

08.45 – 09.00 Welcome day four, coffee / tea

09.00 – 12.00 Concluding and writing session

09.00 – 09.30 Opportunity for peer review panel to ask questions to PE&RC board/office (room GAIA 2) **CANCELLED**. In stead writing and preparing presentation

11.00 – 11.15 meeting with Dean of Sciences and PE&RC Board (room GAIA 2)

11.15 – 12.00 Presentation of preliminary findings by peer review panel (room GAIA 1)

12.00 – 13.00 Lunch and end program (GAIA 2)

Annex 3 *Bio-sketches of the Committee members*

Prof. dr V. (Volkmar) Wolters (chair)

University of Giessen, Germany

Volkmar is Professor of Animal Ecology and Systematic Zoology at the University of Giessen.

After studying biology, psychology and philosophy at the University of Göttingen, he obtained his PhD in 1985 with a study on the role of soil invertebrates in temperate ecosystems. His habilitation was successfully finished in 1991. Having been a Professor for Environmental Sciences at the University of Mainz in the early nineties, he moved to Giessen in 1994 where he currently leads a research group of over 30 people focusing on soil biology, animal diversity, landscape ecology, molecular ecology and ecosystem services.

Being president of the Ecological Society of Germany, Austria and Switzerland (GfÖ) now for several years, he will become the head of the Research Centre for Biosystems, Land Use and Nutrition in June 2015.

He has participated in five EU projects (coordination: 2) and is currently running several DFG- and BMBF-projects (incl. being the Speaker of the DFG Research Group ICON at the Philippines). He is a member of the DFG "Senate Commission on Agro-ecosystems" and of the DFG "German Committee Future Earth". In addition, he is the Vice-chair of the „Advisory Board for Biodiversity and Genetic Resources" of the Federal Ministry of Food and Agriculture.

Prof. dr R. (Reiner) Brunsch

Leibniz Institute for Agricultural Engineering Potsdam-Bornim (ATB), Potsdam, Germany

Reiner is scientific director of the Leibniz Institute for Agricultural Engineering Potsdam-Bornim (ATB) in Potsdam.

After having finished a agricultural education and having studied animal production at the Humboldt University of Berlin, he obtained a PhD scholarship at the same university, which was finalised with a thesis on "Technologically-related influencing on performance of cows in loose housing" in 1986. In this year he became Head of Production at Gut Birkholz with an agreement for conducting applied research at the Humboldt University. In 1990 he proceeded his research career as a research assistant at this university until 1997, when he accepted a position as head of the department "Engineering for Livestock Management" at ATB. In 2001 he got an appointment as Honorary professor at the Humboldt University of Berlin and as scientific director of the Leibniz Institute.

His areas of research include resource efficiency of agricultural production, system engineering in agriculture, reduction of agricultural emissions and animal-friendly milking.

He is a member of several societies and alliances a.o. the European Society of Agricultural Engineers (EurAgEng), Member of Executive Board, the EU Rural Networks' Assembly, the German Agricultural Research Alliance (DAFA), and the Leibniz Research Alliance "Sustainable food production and healthy nutrition" as founder and spokesman.

Prof. dr S. (Scott) Chapman

The University of Queensland, Australia

Scott is a Senior Principal Research Scientist in the CSIRO Agriculture Flagship, and an adjunct Professor with the University of Queensland. He works across the areas of plant science from genetics through physiology to breeding methodology and design to agronomy and climate analysis in order to provide insights and tools to help breeders and farmers. In recent years, he has also led projects to use UAVs to capture image and spectral data for in-season decision-making in breeding programs. The main research tools used by Dr Chapman are crop simulation models (mostly APSIM) and quantitative analysis that relates the environment to crop performance, with specific reference to how different plant varieties or hybrids perform. He has designed and built algorithms in the models to capture complex physiological responses to climate, and the effects of genes on crop phenology in projects with breeding companies and public programs. Across these research areas, Dr Chapman has published almost 100 journal papers, in a career with short stints at the QLD Department of Primary Industries, CIMMYT and UQ followed by 17 years at CSIRO.

Prof. dr B. (Barbara) Ekbom

Swedish University of Agricultural Sciences, Uppsala, Sweden

Barbara is professor in Agricultural Entomology at the Swedish University of Agricultural Sciences, Department of Ecology.

She obtained a PhD degree in Entomology at the Swedish University of Agricultural Sciences, based on her research on biological control of greenhouse pests. Her research focuses on Agroecology, with specific interests in insect-plant and herbivore/predator interactions with emphasis on population dynamics and food web theory. Her research aims at understanding and enhancing conservation biological control in agriculture using methods ranging from molecular biology to landscape ecology. Integrated Pest Management is of particular importance in both research and teaching. She has supervised over 25 PhD students and teaches courses at both the undergraduate and graduate level. She has also worked with crop protection in tropical settings such as Africa. Prof. Ekbom has published widely, and has served on the editorial boards of *Entomologia Experimentalis et Applicata*, *Basic and Applied Ecology*, *Agricultural and Forest Entomology*, and *Annals of Applied Biology*. She has served in numerous national and international academic functions as member of governing councils, advisory boards etc.

Prof. dr B. (Brian) Federici

University of California-Riverside, Riverside, California, U.S.A.

Brian is a Distinguished Professor of Entomology, Microbiology, and Molecular Biology in the Graduate Division of the University of California at Riverside and a member of the Institute of Integrative Genome Biology. He received his B.S. at Rutgers University in New Jersey, and M.S. and Ph.D. degrees in Medical Entomology at the University of Florida, Gainesville. Subsequently, he was a National Institutes of Health post-doctoral fellow at the Boyce Thompson Institute for Plant Research. During Brian's career his research has focused on understanding the basic microbiology and molecular biology of pathogens that attack insects, and use of this knowledge to develop pathogens or their products to control insect pests. His early studies emphasized research on baculoviruses, but over the past fifteen years his laboratory has focused on the insecticidal proteins *Bacillus thuringiensis*, with specific emphasis on mechanisms of gene expression and the development of improved recombinant bacteria for the control of agricultural pests and vectors of human diseases such as malaria, filariasis, and dengue fever. He has served on numerous scientific advisory panels as an authority on insecticidal protein safety for the U.S. Environmental Protection Agency charged with the registration of genetically engineered crops, as well as on similar panels for the World Health Organization and Gates Foundation aimed at controlling mosquito vectors of the above diseases. Brian is fellow of the American Association for the Advancement of Science, and the Entomological Society of America.

Prof. dr J. (John) Grace

Edinburgh university

John became the Professor of Environmental Biology at Edinburgh University in 1992, and Emeritus Professor in 2010. He was the first Head of the University's School of GeoSciences. He is a former President of the British Ecological Society; current President of the Botanical Society of Scotland; Executive Board member of INTECOL (International Association for Ecology), Member of the Science Advisory Board of the Royal Botanic Gardens Edinburgh, and Trustee of the Scottish Forestry Trust. He is a Fellow of the Royal Society of Edinburgh. Recent interests include: carbon fluxes in disturbed forests; carbon dioxide sinks in the tropics; savanna ecosystems; methane fluxes from tropical ecosystems; greenhouse gas fluxes in China; innovation in instrumentation for measuring plant-atmosphere interactions, phenology. He has published over 300 papers and chapters in peer-reviewed international journals and symposia; he has edited or authored ten books, and was the founder co-editor of the journal *Functional Ecology*. He was awarded the BES Medal and the Marsh Award for Climate Change. His current citation rate is about 900 per year and his *h* index is 62. He has recently participated in research consortia funded by NERC: Amazonica, TROBIT. He has participated in a number of projects funded by the European Union; CarboEurope-IP, ICOS, IMECC, and a pilot carbon project in Mozambique. He has served on international review committees in Australia, France, Italy, The Netherlands, USA, Sweden and UK. He has designed, led and taught many BSc and MSc programs.

Prof. dr R. (Richard) Lucas

University of New South Wales, Australia

Richard is employed as full professor at the Centre for Ecosystem Sciences (CES), School of Biological, Earth and Environmental Sciences (BEES), the University of New South Wales (UNSW). The primary area of his expertise is in quantifying and understanding the response of terrestrial ecosystems and environments to change, including that associated with climatic variation, through integration of remote sensing data from various sources. He has also developed methods for extracting relevant information on

terrestrial ecosystems at scales ranging from individual trees to entire regions. Key achievements include the development of object-based methods to update a national classification of habitats in Wales (UK) and a generic scheme for classifying land covers at any location and at multiple scales based on the FAO Land Cover Classification System (LCCS); implementing approaches to quantifying the biomass and structure of forests and woodlands in eastern Australia through integration of radar, optical and ICESAT data; and quantifying mangrove response to both natural and anthropogenic change, including that associated with climatic fluctuation. His collaborative research on lidar and hyperspectral data has established innovative techniques for characterising the species composition, structure and biomass of Australian woodlands at the tree and stand level and quantifying change.

Professor Lucas is increasingly focusing on using the range of techniques developed to better understand the impacts of human-induced and natural change on a diversity of ecosystems, including mangroves, semi-arid woodlands and tropical rainforests. His research is also establishing how time-series of optical and radar remote sensing data can be used to restore previously lost or degraded ecosystems for the benefit of biodiversity conservation and carbon preservation and sequestration.

Prof. dr H. (Helene) Wagner

University of Toronto, Canada

Helene is associate professor in Landscape Ecology at the Department of Biology, University of Toronto Mississauga and the Department of Ecology and Evolutionary Biology, University of Toronto, as well as Associate Faculty in the School of the Environment, University of Toronto. After a diploma in Geography from University of Zurich and a Master's in Statistics from University of Neuchatel, she obtained a PhD in Environmental Sciences from ETH Zurich in 1999, where she also obtained her habilitation in Landscape Ecology in 2005. Her research focuses on how human landscape alteration affects biodiversity patterns and processes. Ecological theories relating to biodiversity rely on assumptions on equilibrium conditions and dispersal that are often unrealistic in human altered landscapes. To determine how landscape affects biodiversity patterns and processes and derive implications for conservation, the research in her lab falls into three complementary topics: spatial ecology, metacommunity dynamics, and landscape genetics. Depending on the research question, she combines field experiments, surveys of natural populations and communities and computer simulation, using a broad range of methods including spatial and multivariate statistics, GIS, molecular genetics, soil analysis and spatiotemporal dynamic modelling. She currently serves on the editorial boards of Ecology and Ecological Monographs.

Prof. dr W. (Wouter) Saeys

KU Leuven, Belgium

Wouter is assistant professor in the faculty of bioscience engineering (Division of Mechatronics, Biostatistics and Sensors (MeBioS)) and head of the subdivision Agrotech-WS.

He is a lecturer in "Multiscale Physics of Biological systems" . His PhD project has been on "Development of a composition sensor for animal manure and optimisation of a manure separator for desired composition of the thin fraction." As a postdoc he worked on Multiscale modelling of light propagation in biological tissue and did research on more mechanistic pre-processing and calibration methods for spectroscopic analysis of biological products with applications in the agricultural and food industry"

His areas of expertise are: Near-Infrared Sensing of Manure Nutrients. Solid-Liquid Separation: Modelling and Control, System Identification and Control, Multivariate Analysis & Chemometrics, Partial Least Squares regression (PLS), least Squares Support Vector Machines (LS-SVMs) and Functional Data Analysis (FDA).

Dr C. (Chris) Mollema (secretary)

Radboud University, Nijmegen

Chris is senior advisor research at the central staff department 'Strategy & Development' since 2006. He had a similar position at the department 'Research Strategy' at Wageningen UR (1998-2006). In these jobs he is/was very much involved in research quality, assessments of research units and future planning. After his MSc (Biology) at Utrecht University and PhD at Leiden University he became senior researcher 'Breeding for Resistance to Insect Pests' at Wageningen UR (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 *Euphytica* (1988-1998). From 2001-2005 he was member of the Committee on Agriculture, Food and Biotechnology of the European Science Foundation's programme COST that selects and supervizes European collaborative projects. He also

served in 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.