

NVAO
limited
initial

accreditation

Panel report

wo-master
Biobased Sciences
Wageningen University

9 April 2018

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1 Executive summary

The Accreditation Organisation of the Netherlands and Flanders (NVAO) received a request for an initial accreditation procedure regarding a proposed wo-master Biobased Sciences at Wageningen University (WUR). NVAO convened an expert panel, which studied the information available and discussed the proposed programme with representatives of the institution and the programme during a site visit.

The following considerations have played an important role in the panel's assessment.

The two-year master programme Biobased Sciences aims to fulfil the training needs for the emerging biobased and circular economies, which require multi- and interdisciplinary as well as in depth disciplinary education and training. In this context the panel appreciates that the learning outcomes comply with the Dublin descriptors, obviously reflect an academic orientation and are divided in disciplinary, interdisciplinary and general ones. According to the panel they deserve more specification, as especially the interdisciplinary ones are rather vague and might not be sufficient informative on the qualifications of the graduates for the intended labour-market.

When discussing the concept of interdisciplinarity with representatives from the programme, the panel encountered mixed, not yet fully crystallised perceptions of interdisciplinarity. Stakeholders described more explicitly the balance and interdependence that they expect between disciplinary and interdisciplinarity, especially when it comes to crucial concepts like climate and environmental impact assessment, chain management, ethics, policy developments and economic feasibility. The panel recommends to adjust the learning outcomes in order to better specify the programme's concept of interdisciplinarity, while retaining an appropriate balance between disciplinary and multi- or interdisciplinary aspects. The panel is convinced that more specified learning outcomes will remove its concerns.

The programme meets standard 1.

The panel found an ambitious programme structured in line with WUR standards, which is to be realised by enthusiastic and qualified staff in a well-equipped environment. The curriculum consists of: two foundation courses (12 EC) followed by specialisation courses in three specialisations¹(24 EC), free optional courses (12 EC), Academic Consultancy Training (ACT, 12 EC), an internship (24 EC) and a MSc thesis (36 EC). The course objectives cover the intended learning outcomes and provide further specifications of these. The panel has some important concerns regarding the design of the programme. The issues are: (1) insufficient interdisciplinarity throughout the programme and in the assessments, (2) whether all study paths lead to full realisation of the intended learning outcomes and (3) lack of a coherent and substantial biobased orientation in courses.

(1) The foundation courses that were presented as interdisciplinary courses appear to have a more multidisciplinary than interdisciplinary character. This is especially the case for Principles of biobased economy. This course consists of ten separate modules of which students choose at least six in order to introduce students to the different subjects of the biobased sciences program in a general way and to compensate lack of prior knowledge (depending on their BSc). All students have to pass the same exam independent of the modules they chose. Thus the starting level of the students is to some extent harmonised.

¹ Biomass production and carbon capture, Biorefinery and conversion or Biobased and circular economy

The other foundation course, Circular economy, includes face-to-face education and focuses on a systems approach as an interdisciplinary method. The thesis is presented as interdisciplinary. The research project of the student focusses for 80% on one of the disciplinary specialisations, 20% will be used to broaden the research project to another specialisation. According to the panel this also has a more multi- than interdisciplinary character as it should address two separate research questions from two chair groups in a 80:20 balance which do not necessarily address the interaction. The panel appreciates the ACT project, which is a general WUR course element. However, such projects may also vary in multi- and interdisciplinarity although the staff emphasised that specific (interdisciplinary) projects will be designed for this programme. The panel concludes that in fact interdisciplinarity is mainly embedded in the foundation courses, especially in the second course and hence limited to approximately 5-10% of the curriculum. The representatives from the professional field confirmed their appreciation for multi- and interdisciplinarity in the programme. However, given the interdisciplinary ambitions of the programme, the panel comes to the conclusion that the interdisciplinarity needs to be developed further. The panel therefore strongly recommends to a) define interdisciplinarity and multidisciplinary b) ensure a better interdisciplinary approach in the foundation of in the programme c) ensure more and aligned embedding of interdisciplinarity throughout the program courses and address this in assessments and d) improve the learning outcomes for the ACT and Master thesis to include interdisciplinarity.

(2) A potential risk according to the panel is that not all possible study paths indeed lead to full realisation of the intended learning outcomes. The programme provides several more or less conditioned choices of (combinations of) courses within specialisations. The complicated process for choosing adds to this concern. During the site visit some factors were mentioned that may reduce the risk noticed: criteria conditioning choices and substantial advice and guidance from mentors. According to the panel this risk may be reduced further if courses include 'biobased' and 'interdisciplinarity' more substantially.

(3) The panel noticed that only six biobased courses were newly developed for this programme²; all the other courses also serve other degree programmes. The programme management and teaching staff provided some examples of courses that have already been adapted to meet the needs of biobased sciences (like Sustainability analysis) or will be adapted (like Seaweed biology and cultivation).

The programme management has the intention to evaluate all courses on their contribution to the biobased and interdisciplinary approach. In doing so the programme will be assisted by the university's educational support service. The panel recommends to pursue this further in the near future in close cooperation with the programme committee.

The programme partially meets standard 2.

At first, the panel had confidence in the organisation of testing and assessment for the programme, as the WUR is known for its clear and effective organisation and practice in this respect. During the site visit it became increasingly clear that interdisciplinary testing and assessment did not materialise yet to the extent one should expect. The panel welcomes the explicit expertise on testing and assessment in the examination committee and suggests to appoint an additional member from within the new programme.

The practice of using rubrics for assessing ACT, internships and the thesis is a good one, but the panel missed criteria regarding the interdisciplinary biobased sciences approach. The panel

² These courses are piloted in existing degree courses: Biosystems Engineering, Biotechnology en Plant Sciences.

therefore recommends adjusting the assessment forms. It appreciates that this process has already started for some assessment forms and has been discussed at the level of the institution as well.
The programme partially meets standard 3.

The extended duration of the programme is justified by several arguments. First of all, the programme aims for specialisation and interdisciplinarity as well as for a solid scientific focus with practice oriented components. This requires theoretical education and training, but also an internship with a workload of 24 EC.

Second, representatives of the professional field emphasised that students should not only have in depth disciplinary knowledge, but also ought to have acquired research skills, communication skills, practical lab skills and business skills. As the programme is interdisciplinary, the thesis should be the result of an interdisciplinary achievement with a work load of at least 36 EC.

The panel is convinced that these arguments are valid. It therefore agrees that the programme needs two years to cover all the qualifications that graduates should master in order to be competitive on the international academic Biobased Sciences job market.

The extended duration is justified

The panel concludes that the master programme on Biobased Sciences offered by Wageningen University fully meets one out of three standards. The other two standards are met partially, but the panel is confident that the programme will be able to fulfil the necessary conditions to fully meet these standards within a reasonable period of time. Given these considerations, the panel advises NVAO to take a conditionally positive decision regarding the quality of the proposed programme wo-master Biobased Sciences at Wageningen University. The panel advises to impose the following conditions:

- a. Define and specify interdisciplinarity and multidisciplinary.
- b. Include interdisciplinarity in the learning outcomes, criteria and assessments.
For example, pay more attention to chain and systems thinking, climate and environmental impact, social impact analysis, supply chain management, policy developments, economic feasibility, (risk) perception and communication.
- c. Adapt (existing) courses to more explicit inclusion of interdisciplinarity in the learning outcomes.
- d. Provide a better foundation of interdisciplinary approaches in the programme to ensure a broadened and extended interdisciplinary basis in the programme for all students (independent from the specialisations they choose).
- e. Include academic level elements with appropriate learning outcomes and assessments for all students on 1) ethics and philosophy related to biobased sciences and transition paths; and 2) societal aspects of biobased sciences & innovation.

The Hague, 9 April 2018

On behalf of the assessment panel convened for the initial limited accreditation assessment of the wo-master Biobased Sciences at Wageningen University,

Prof. P. (Patricia) Osseweijer
(chair)

drs. Johanneke Braaksma
(secretary)

2 Introduction

2.1 The procedure

NVAO received a request for an initial accreditation procedure including programme documents regarding a proposed wo-master Biobased Sciences. The request was received on 18-07-2017 from Wageningen University.

An initial accreditation procedure is required when a recognised institution wants to award a recognised bachelor's or master's degree after the successful completion of a study programme. The procedure for initial accreditation is slightly different from the approach for programmes that have already been accredited. Initial accreditation is in fact an *ex ante* assessment of a programme. The programme becomes subject to the normal accreditation procedures once initial accreditation has been granted.

To assess the program, the NVAO convened an interdisciplinary panel of experts (see also Annex 1: Composition of the panel). The panel consisted of:

Chair:

- Prof. dr. P. (Patricia) Osseweijer – professor Science Communication and leader of the 'Section Biotechnology and Society' at Delft University of Technology;

Panel members:

- Prof. dr. M.J.E.C. (Marc) van der Maarel – professor Aquatic Biotechnology and Bioproduct Technology (ENTEG), University of Groningen;
- Dr. ir. A.P.H. (Annita) Westenbroek - Director Dutch Biorefinery Cluster;
- Prof. dr. J.H. (Han) de Winde – professor Industrial Biotechnology, Institute of Biology, Leiden University; Vice-dean Science Faculty, Leiden University;

Student member:

- M.J. (Menno) van Gameren - Student bachelor Future Planet Studies University of Amsterdam

On behalf of the NVAO, Frank Wamelink and Johanneke Braaksma were responsible for the process coordination and the drafting of the experts' report.

This composition reflects the expertise as required by NVAO. (Annex 1: Composition of the panel). All the panel members signed a statement of independence and confidentiality.

The panel has based its assessment on the standards and criteria described in the NVAO Assessment framework for the higher education accreditation system of the Netherlands (Stcrt. 2016, nr 69458).

The following procedure was undertaken. The chairman and process coordinator met and reviewed the documents provided by the Institution. They asked several questions and requested additional documents to complete the background information. The panel members prepared the assessment by analysing the documents provided by the institution (Annex 3: Documents reviewed) and were requested to give a preliminary feed-back as a basis for the preparatory meeting. The panel organised a preparatory meeting on 15 February 2018, the day before the site visit.

During this meeting, the panel members shared their first impressions and formulated questions for the site visit with special attention to concerns related to the standards.

The site visit took place on 16 February 2018 at Wageningen University. During this visit, the panel was able to discuss the formulated questions and to gather additional information during several sessions (Annex 2: Schedule of the site visit). Afterwards, the panel discussed the findings and considerations and pronounced its preliminary assessments per theme and standard. At the end of the site visit, a brief summary of the initial findings was orally presented to the institution.

Based on the findings, considerations and conclusions the secretary wrote a draft advisory report that was first presented to the panel members. After the panel members had commented on the draft report, the chair endorsed the report. On 22 March 2018 the advisory report was sent to the institution, which was given the opportunity to respond to any factual inaccuracies in the report. The institution replied on 4 April 2018. All suggested corrections were adopted. Subsequently the final report was endorsed by the panel chair. The panel composed its advice fully independently and offered it to NVAO on 9 April 2018.

2.2 Panel report

The first chapter of this report is the executive summary of the report, while the current chapter is the introduction.

The third chapter gives a description of the programme including its position within the institution, the Wageningen University and within the higher education system of the Netherlands.

The panel presents its assessments in the fourth chapter. The programme is assessed according to the themes and standards in the Initial Accreditation Framework. For each standard the panel presents an outline of its findings, considerations and a conclusion.

The outline of the findings are the objective facts as found by the panel in the programme documents, in the additional documents and during the site visit. The panel's considerations consist of the panel's judgments and subjective evaluations regarding these findings and their relative importance. The considerations presented by the panel form the basis of a concluding overall assessment.

The panel concludes the report with a table containing an overview of its assessments per standard.

3 Description of the programme

3.1 General

Country	: The Netherlands
Institution	: Wageningen University
Programme	: Biobased Sciences
Level	: master
Orientation	: academic (in Dutch: Wetenschappelijk Onderwijs)
Specialisations	: - Biomass Production and Carbon Capture - Biorefinery and Conversion - Biobased and Circular Economy
Degree	: Master of Science
Location(s)	: Wageningen
Study Load (EC)	: 120 EC
Field of Study	: Agriculture and natural environment (in Dutch: Landbouw en natuurlijke omgeving)

3.2 Profile of the institution

Wageningen University & Research (WUR) is a collaboration between Wageningen University and the Wageningen Research foundation. The mission of Wageningen University & Research is 'To explore the potential of nature to improve the quality of life'.

A staff of 6,500 and 10,000 students from over 100 countries work around the world in the domain of healthy food and living environment for governments and the business community-at-large.

The domain of Wageningen University & Research consists of three related core areas: Food and food production, Living environment and health, Lifestyle and livelihood. The WUR combines specialised research and education as well as the various fields of natural and social sciences.

The incorporation in education and practice of expertise and scientific knowledge is known as the Wageningen Approach. Wageningen University is a Publicly funded institution. It passed the Institutional Audit with positive result in July 2012. Just before the visit of the panel the next Institutional Audit took place in order to be recognized for the next six years.

3.3 Profile of the programme

The two-year master programme Biobased Sciences aims to respond to current developments towards a more biobased society requiring a variety of specialisations as well as an interdisciplinary mindset. Therefore the intended core focus of the programme is interdisciplinarity, completed by three specialisations addressing: (1) the initial biomass production and carbon capture, (2) the subsequent biorefinery and conversion processes necessary to produce biobased products and services, as well as (3) related business models and economic and societal aspects of the transition to a biobased society. Graduates will be able to assess opportunities and challenges of the biobased economy from an interdisciplinary perspective combined with in-depth disciplinary knowledge. Thus they will be able to contribute to research and developing biobased concepts, products or processes considering their technical, economic and societal sustainability. Graduates will likely be working in a transition economy where they need to interact with different disciplines. The programme applies for an initial accreditation with extended duration.

4 Assessment per standard

This chapter presents the evaluation of the standards by the assessment panel. The panel has reproduced the criteria for each standard. For each standard the panel presents (1) a brief outline of its findings based on the programme documents and on documents provided by the institution and the site visit, (2) the considerations the panel has taken into account and (3) the panel's conclusion. The panel presents a conclusion for each of the standards, as well as a final conclusion.

The assessment is based on the standards and criteria described in the NVAO Assessment framework for the higher education accreditation system of the Netherlands (Stcrt. 2016, nr 69458). Fundamental to the assessment is a discussion with peers regarding the content and quality of the new programme.

Regarding each of the standards, the assessment panel gives a substantiated judgement on a three-point scale: meets, partially meets or does not meet the standard. The panel subsequently gives a substantiated final conclusion regarding the quality of the programme, also on a three-point scale: positive, conditionally positive or negative.

4.1 Standard 1: Intended learning outcomes

The intended learning outcomes tie in with the level and orientation of the programme; they are geared to the expectations of the professional field, the discipline, and international requirements.

Outline of findings

The application document describes how the programme aims to respond to the current emergence of a circular and biobased-focused society requiring disciplinary specialisations as well as an interdisciplinary mindset. The programme intends to prepare students for a career in which they need in-depth disciplinary knowledge as well as an overarching understanding of the (interdisciplinary) system in which this knowledge is applied. Future graduates are likely to be working in a transition economy. They may end up for example in the agrifood sector, creating more value from agricultural crops; in the chemical, energy or materials sector, developing new circular biobased products; or in financial institutions and regional or (inter)national authorities.

The macro efficiency report³ refers to the comparison of the programme with other Dutch master programmes offering similar subjects. It concludes that this programme on biobased sciences is unique in its combined (multi) disciplinary and interdisciplinary approach. The report also confirms that the programme addresses the societal needs regarding a circular economy as well as scientific needs as expressed in for example the Dutch National Science Agenda and the European Horizon 2020 programme. Furthermore reference is made to the compliance of the programme with the Strategic plan of the WUR and the needs of the labour market.

The 10 learning outcomes of the programme presented are distributed among three categories: disciplinary (3), interdisciplinary (2) and general (5). The disciplinary learning outcomes focus on the ability to apply disciplinary knowledge and to design new biobased concepts, products or processes which can replace petrochemical applications. The interdisciplinary learning outcomes concentrate on cooperation in interdisciplinary teams and assessing technological, ethical, societal and economic consequences of biobased designs.

³ Assessment establishing the demand for graduates in the labour market.

The general learning outcomes cover the development of an academic attitude, scientific communication, developing and executing research and reflecting upon personal functioning and learning.

The learning outcomes reflect an academic and biobased character. In the documentation it is substantiated that they comply with the Dublin descriptors. It is also described how these learning outcomes will facilitate that: 'graduates will be able to assess opportunities and challenges of the biobased economy from an interdisciplinary perspective and will have developed expertise in one of the three disciplines (specialisations). Based on this, they are able to research and develop robust biobased concepts, products, or processes and consider their technical, economic, and societal sustainability.'

The panel questioned the definition of interdisciplinarity in this programme, more specifically in the learning outcomes. Therefore the panel discussed the learning outcomes with almost all the interlocutors. When asked about interdisciplinarity, the programme management and teaching staff indicated which parts of the programme contribute to the realisation of the learning outcomes addressing interdisciplinarity. They also mentioned the cooperation of staff from different disciplines within the programme and made additional statements like 'we hope it will be possible to realise and increase interdisciplinarity in the programme'.

The representatives from industry interviewed by the panel emphasised the importance of the multi- and interdisciplinary scientific programme, which they said would clearly fulfil the needs of the industry. They underlined the importance of chain and system thinking, realising that this comes at the cost of disciplinary approaches. At the same time they indicated that disciplinary expertise is also of the utmost importance, especially for research oriented functions. Industry faces an increasing demand for flexibility in dealing with crucial concepts such as bioconversion and chain management in relation to (sustainability) impact analysis including life cycle analysis, complemented with affinity with economic and marketing aspects. The stakeholders representing industry currently meet these needs by offering their staff traineeships and in company training programmes. The proposed degree programme would provide more initial training for their future employees, which the stakeholders welcome. They appreciate a good balance between disciplinary and multi- or interdisciplinary elements in the programme. A preferred 20:80 balance was mentioned.

The field committee representing the labour market of the biotechnology programme, discussed an outline of the biobased sciences programme in 2016. The minutes of these discussions reflect a similar opinion and additionally stress the importance for graduates of being able to communicate with experts from different disciplines in the biobased field.

Considerations

The panel appreciates the initiative of the WUR to address the training needs for the emerging biobased and circular economies. It agrees that the combination of disciplinary and multi- and interdisciplinary education provides a clear added value. In this context it makes sense to the panel to distinguish three categories of learning outcomes: disciplinary, interdisciplinary and general ones. The learning outcomes comply with the Dublin descriptors and obviously reflect an academic orientation. According to the panel the learning outcomes deserve more specification, in particular the interdisciplinary learning outcomes. Interdisciplinarity is currently defined rather ambiguous and vague. The current learning outcomes do not provide sufficient information on the qualifications of the graduates for the intended labour market.

During the site visit, the panel investigated how exactly the programme defines interdisciplinarity. Does it involve integration of disciplines and/or integration regarding chains and systems? The answers the panel got from representatives of the programme provided a mixed, not yet fully crystallised perception of interdisciplinarity. Interlocutors often referred more to multidisciplinary, defined as 'knowledge of more than one discipline' than to interdisciplinarity, 'defined as integrated perspectives based on knowledge of more than one discipline'. The representatives of industry described more explicitly the balance and interdependence that they expect between disciplinary and interdisciplinarity in the learning outcomes and consequently in the programme (see also standard 2). The panel supports the interpretation of these stakeholders regarding the required multi- and interdisciplinarity when it comes to crucial concepts like climate and environmental impact assessment, chain management, ethics, policy developments and economic feasibility. The panel suggests to incorporate a clear definition of multi- and interdisciplinarity in the programme's learning outcomes, and explicate them in a more precise formulation of the learning outcomes. The panel also agrees with the programme management that the economic perspective as presented in one of the foundation courses, might contribute substantially to an interdisciplinary character of the learning outcomes and the programme. The presented learning outcomes only touch upon the concepts mentioned above. The panel recommends to adjust the learning outcomes in order to better specify the programme's concept of interdisciplinarity (and include a definition), meanwhile retaining an appropriate balance between disciplinary and multi- or interdisciplinary aspects.

The panel is confident that further discussion and elaboration of the concept of interdisciplinarity within the team and with representatives from the industry will result in better specified learning outcomes, thus removing the panel's concerns. The panel is strengthened in its confidence by the strong reputation and appropriate structure of the WUR for multi- and interdisciplinary initiatives.

Conclusion

The programme meets standard 1.

4.2 Standard 2: Teaching-learning environment

The curriculum, the teaching-learning environment and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.

Outline of findings

Curriculum

Like other multi- or interdisciplinary programmes at WUR, the programme has a typical 'Wageningen structure'. This T-shaped profile on the one hand allows master students to deepen their disciplinary knowledge via specialisations, an internship and the MSc thesis. On the other hand they can broaden their horizons via the Academic Consultancy Training (ACT) that is compulsory for every WUR student, via free optional courses and via some integrating courses. The proposed programme on biobased sciences consists of: foundation courses (12 EC) followed by specialisation courses (24 EC), free optional courses (12 EC), Academic Consultancy Training (12 EC), an internship (24 EC) and a MSc thesis (36 EC).

The two foundation courses, Principles of biobased economy and Circular economy, intend to introduce students to the core themes of the programme and its interdisciplinary systems approach. The two courses differ in structure and didactic design. In the past, all material developed for the new course on Principles of biobased economy was in a distance learning mode.

In the new study programme it will be an on-campus. Students are expected to choose at least six out of ten modules in such a manner that the modules compensate for the lack of prior knowledge (depending on their BSc programme). All students have to pass the same exam independent of the modules they chose. Thus the starting level of the students is harmonised to some extent.

The other foundation course, Circular economy, includes face-to-face education and comprises an introduction to the systems approach as an interdisciplinary method. This course also includes elements such as life cycle analysis (LCA) and agent based modelling (ABM) in the context of a circular economy and an integrated case study about circular design.

Following these foundation courses students have to choose one out of three specialisations: Biomass production and carbon capture, Biorefinery and conversion or Biobased and circular economy. Students are admitted to the Master specialisations based on their bachelor-level knowledge in the specific area concerned. When students have a different background they have to follow 'linkage courses'. They can do so either via free optional courses in their bachelor programme or via following some courses (max 30EC) in between their bachelor and master education. Within the specialisations students make some more choices taking into account four types of criteria which intend to ensure a certain mix of courses, an appropriate internship and the thesis.

The WUR encourages students to personalise their study path via free optional courses which as a general rule can be chosen from all MSc courses offered at WUR. However, students are expected to tailor their choices to their thesis topic and career ambitions.

The academic consultancy training course (ACT) functions as a learning community in which groups of 5-7 students and external commissioners work on a case for 8 weeks. Students of the master biobased sciences have to choose a biobased topic. Still they can either opt for an ACT project focussing on sustainability or one which focusses on entrepreneurship.

Internships are generally realised outside the university and provide possibilities for students to apply what they have learned so far, to practice and further develop professional skills and to experience working in a professional environment. Students have to write a proposal, perform the work plan and write a report in which experiences and results are brought together.

In order to complete their studies, students have to write a research proposal, execute the research and write and defend their MSc thesis. The thesis has to be carried out in one of the chair groups of the chosen specialisation. In addition to this a research question from another specialisation has to be addressed. The balance between these components will be 80:20.

Thus students have to demonstrate that they reached the appropriate master level in their topic and are able to work in an interdisciplinary way.

The documentation includes brief systematic descriptions of the courses. These contain course objectives, teaching methods, literature and information about (parts of) the examinations, like forms and weighting. A schematic overview is also provided which demonstrates how the learning outcomes are related to courses. This scheme shows that disciplinary learning outcomes are well covered by courses. Two courses⁴ in the biomass specialisation are not yet connected to any learning outcome. Although the panel enquired about these missing connections, this remained unclear, as the courses were not yet developed.

It also struck the panel that the interdisciplinary learning outcomes were almost all not connected to the specialisation courses.

⁴ Advanced bioresources and European forest resources and the bio-economy

A notable exception is the learning outcome about the assessment of technological, ethical, societal and economic consequences, to which five out of seven courses in the Biobased and circular economy specialisation are connected. Four out of five general learning outcomes are apparently not served by courses except in the ACT, the internship and the thesis. Teaching staff explained that learning outcomes are only connected to courses in the scheme if they are explicitly tested and assessed in examinations.

The scheme furthermore shows that there are six new courses in the programme: the two foundation courses and four for the specialisations. This corresponds to a grand total of 18 to 24 ECTS of new courses for the proposed Biobased Sciences Master program of 120 EC, depending on the chosen specialisation. As one of the foundation courses consists of existing MOOC modules, the new elements for this Master program amount to 10-15%. The number of courses available per specialisation varies. For biomass there are eight, six of which are existing courses that are also offered within other programmes, and two of which are newly developed for this specialisation. The two other specialisations have seven courses each, including one newly developed course per specialisation.

The panel had the opportunity to study several course materials: MOOCs, course guides on blackboard, some literature, reports on ACT projects and a MSc thesis of another programme addressing a biobased topic. The panel was explained that MOOCs have their origin in regular courses of WUR and that materials from MOOCs may be used in courses in the programme on biobased sciences. This was illustrated by the Micromaster Biobased sciences for sustainability which includes MOOCs on Advanced biorefinery, Advanced biobased conversion and Circular economy. The panel welcomed that, although the programme claims to concentrate on non-food, the MOOC on advanced biorefinery also includes food aspects. Thus the programme seems to pay attention to the whole spectrum the panel would expect in a biobased sciences programme. However, it did struck the panel that several aspects one might expect in an advanced course on biorefinery were lacking in this particular MOOC. The panel recognised that parts of the MOOC materials shown might indeed be useful as introductory elements in the programme, but that generally the level of the materials appeared not to fully comply with the scientific master level. The course guides provide clear information. In some cases the panel wondered whether the assignments indeed are at the appropriate master level. The panel studied several examples of the ACT reports from other programmes. These reports illustrate the ACT projects well. It remained unclear though to the panel how these projects are assessed and how interdisciplinarity will be guaranteed, as students working in their team might divide tasks conforming to their disciplinary background. The rubric for the assessment of ACT projects includes 39 criteria to be assessed by the coach and the commissioner. The rubric pays considerable attention to cooperation and communication. Some criteria address cross-disciplinary contributions of students.

During the meetings the panel concentrated on questions regarding (1) the interdisciplinarity, and (2) whether all study paths guarantee that students will fully realise the intended learning outcomes.

(1) The panel investigated how interdisciplinarity is defined within the programme and where and how it can be recognised in the curriculum. The definition of interdisciplinarity remained implicit in the discussions with programme management and teaching staff. Nevertheless, both groups explicitly stated where interdisciplinarity can be found in the programme: in the foundation courses, in the (biobased earmarked) ACT projects and in the thesis. When asked for more indications of interdisciplinarity they referred to inter-linkages in the programme via the free optional choices of students and in the course Sustainability analysis, one of the specialisation courses. A few other examples were given. The Seaweed biology and cultivation course for instance will be adapted to apply a more biobased approach. Cases dealing with integrative aspects will be used

and students will be trained in understanding the interconnections within the whole chain from biomass to products and processes in practicals. Students who had compared the proposed programme to their current study programmes⁵, indicated that they expect that the multidisciplinary value of the programme on Biobased Sciences will be added via the foundation courses, the free optional courses and the conditional choices that they make within the specialisations. The interdisciplinarity would be most profound in the ACT, where students learn to work together in multidisciplinary teams.

A recurrent indication for interdisciplinarity was the cooperation of staff from different disciplines in courses, projects and practicals. The staff repeatedly showed a recognition of the need that multidisciplinary is still to be further developed in the direction of interdisciplinarity.

(2) The programme offers three specialisations each providing students several more or less conditioned choices of (combinations of) courses. This results in many possible individual study paths. The panel wondered whether all study-paths allow students to fully realise the intended learning outcomes. The complicated process of choosing in the specialisations adds to this concern. The panel revealed that in both the specialisations Biomass production and carbon capture and Biorefinery and conversion it is possible to choose only courses without an interdisciplinary learning outcome. In fact the interdisciplinarity in both two specialisations predominantly has to come from the internship, the MSc thesis and the ACT project.

The panel asked teaching staff and students whether they share this concern. Both groups of interlocutors referred to adequate and regular individual study guidance and advice about choices via a personal mentor.

Intake, mentoring and facilities

The programme is expected to be attractive for Dutch and international students with a background in plant sciences, (chemical) engineering, and management with a focus on (agro)technology.

In order to be admitted, applicants are expected to have a BSc degree (or equivalent) with a grade point average (GPA) of at least 70% of the relevant maximum grade in biotechnology, (molecular) biology, biochemistry, life sciences, chemical engineering, plant sciences, animal sciences, environmental science and technology, agrotechnology, management and consumer sciences, industrial or systems engineering, economics and policy, or comparable. They also have to submit a curriculum vitae; a motivation letter, which should include an argumentation for the applicant's target specialization (which in principle is expected to link to the applicant's completed bachelor programme); and a proof of sufficiency in terms of written and oral command of the English language.

Once the students are admitted to the programme, they face entrance requirements for some courses and criteria for the choices they have to make during the programme. They get a mentor who offers them study guidance and advice in making these choices. Students in other programmes who have experienced such a mentor system reported regular and satisfying contacts with these mentors, who are lecturers with a part time position as mentor. Teaching staff said that, if necessary, courses as well as admission criteria may be adjusted based on their experiences as mentors. In addition to the mentors there is also a central Student Service Centre where students get support with administrative and legal issues, study delay and personal questions. Other extracurricular facilities include an incubator for start-ups by WUR students (StartHub Wageningen) and F&A Next, an initiative connecting food and agriculture start-ups with investors.

⁵ Management, economics and consumer studies, Biotechnology and Plant sciences

Staff

The provided documentation reports an estimated staff-student ratio of 1:15. The curricula vitae show that several teaching staff are involved in relevant biobased research. Surprisingly none of them specialised in or has extended experience within philosophy and or ethics, while knowledge about ethics and considering societal and ethical issues is profoundly stated as a learning outcome. Programme management explained that this expertise will be included by lecturers who cope with ethical questions in the context of their own discipline. A substantial number of staff (22) have or are preparing for a University Teaching Qualification (UTQ). Some have a senior UTQ (4). In total 42 staff members are mentioned to be involved with the programme. This relatively large number of staff is typical of the Wageningen model that involves courses being used in several programmes. This not only raises questions regarding the specificity of courses for this particular degree programme but also regarding coordination and cooperation of staff. Teaching staff, programme management, the examination committee and the programme committee all expressed confidence that the necessary conditions for offering a coherent programme are fulfilled. They all referred to the experience and scale of WUR in this respect. Meanwhile the programme committee's representative showed not to have a full insight into the programme yet. He remarked that some questions raised by the panel did not touch upon his specialisation.

Considerations

The panel found an ambitious aim to serve employment needs with interdisciplinary and multidisciplinary knowledge required in view of a transition to a biobased economy, served by a program with 10-15% new courses, structured in line with WUR standards, which is to be realised by enthusiastic and qualified staff for the three specialisations in a well-equipped environment. The program shows an adequate level of multidisciplinary but is as yet insufficiently oriented to interdisciplinarity. Moreover, the staff composition lacks professional competence at an academic level in philosophy and ethics, knowledge and expertise of which was admitted to be an important learning outcome of the new programme, and which is expected to add to interdisciplinary learning outcomes. The panel appreciates the attention paid to the whole spectrum of a biobased economy, including attention for food in this new programme. The panel remains concerned about how each and every course relates to the learning outcomes as the provided scheme reveals some omissions which were not all clarified during the site visit. The panel has some important concerns regarding the design of the programme. The issues are: (1) insufficient interdisciplinarity throughout the programme and assessment of such concepts, (2) whether all study paths lead to full realisation of the intended learning outcomes and (3) lack of a coherent and *substantial biobased orientation* in courses.

(1) The panel's main problem with the interdisciplinary ambitions of the programme is that interdisciplinarity is neither clearly defined nor consequently embedded in the programme or properly assessed. The foundation courses presented as interdisciplinary courses appear to have a more multidisciplinary than interdisciplinary character. This applies especially for Principles of biobased economy. This course consists of ten separate modules with, as far as the panel could investigate, little interdisciplinary integration. Also, the course will mainly be offered in a distance learning mode (MOOC-modules). As the (draft) exam was not yet available the panel could not check whether some integration might be incorporated in it. The course merely seems an introduction to the different subjects of the biobased sciences program in a very general way, allowing deficiencies to be addressed and hence creating some harmonisation of the full student groups entry knowledge. This is strengthened by the examination as all students have to pass the same exam independent of the six modules they chose.

The panel appreciates the intended programme of the other foundation course, Circular economy, in which more face-to-face education is planned between staff and students as well as between

students. This course focusses on a systems approach and part of the examination will be a case study report. As such this course better includes the interdisciplinary intentions of the programme. Other elements mentioned as interdisciplinary are the Master Thesis, the ACT projects and a few courses from the three specialisations. The panel considered however that the thesis has a more multi- than interdisciplinary character as it should address two separate research questions from within two chair groups in an 80:20 balance which do not necessarily address the interaction. Supervision will be provided by both chair groups. The panel appreciates the ACT project which is a general WUR course element. However, such projects may also vary in multi- and interdisciplinarity and assessment criteria on individual learning outcomes for interdisciplinary approaches and results are lacking. In addition it is worrying that students can choose specialisation paths that do not have a single course in which interdisciplinarity is a course objective.

The panel concludes that in fact interdisciplinarity is mainly embedded in the foundation courses, especially in the second course and hence limited to approximately 5-10% of the curriculum. The panel observed several more multidisciplinary elements, including the thesis and the ACT projects. The representatives from the professional field confirmed their appreciation for multi- and interdisciplinarity in the programme. In conclusion, and taking into account the interdisciplinary ambitions of the programme, the panel assesses the extent to which interdisciplinarity is currently addressed as too weak. The panel strongly recommends to a) define interdisciplinarity and multidisciplinary b) ensure a better interdisciplinary approach in the foundation of in the programme c) ensure more and aligned embedding of interdisciplinarity throughout the program courses and address this in assessments and d) improve the learning outcomes for the ACT and Master thesis to include interdisciplinarity. Adjusting the foundation course on Principles of biobased economy should be seriously considered to achieve this as well as ensuring that more compulsory courses in the specialisations are interdisciplinary and that integrated assignments and examinations are included in the programme.

(2) The panel was concerned whether all possible study paths fully realise the intended learning outcomes. This concern has partly been counterbalanced by the explanations given during the site visit. The panel understood that most choices that students have to make are conditioned in one way or another and that substantial guidance is provided in making choices. Also the importance of choices made in the previous bachelor programme turned out to be important. The website mentions that 'the pre-education determines the most suitable and realistic specialisation'. The panel is of the opinion that this may be misleading to students applying for the programme as it seems possible to choose a study path not preparing adequately for all intended learning outcomes. This risk may be reduced when courses are adjusted in order to more substantially include biobased sciences and interdisciplinarity. For example by paying more attention to chain and systems thinking, climate and environmental impact assessments (including life cycle analysis, cradle to cradle, cradle to gate, full cycling concepts), social impact analysis, supply chain management, policy developments, economic feasibility, (risk) perception and communication.

(3) The panel noticed that six biobased courses were newly developed for this programme⁶ and five new biobased courses were already set up as an optional course in preparation for this new master programme. All the other courses also serve other degree programmes. This touches upon the panel's question to which extent courses are or will be adapted to provide a coherent programme with a focus on the learning outcomes specified for this new biobased sciences programme. Programme management and teaching staff provided some examples of courses that have already

⁶ These courses are piloted in existing degree courses: Biosystems Engineering, Biotechnology en Plant Sciences.

been adapted (such as Sustainability analysis) or that they plan to adapt (such as Seaweed biology and cultivation). These examples convinced the panel that there is a willingness to adapt courses. To the panel's opinion this deserves some central coordination which the panel expected to come from the programme management and the programme committee. This should comprise ensuring adequate communication between lecturers to achieve alignment between course elements including those which are serving in other programmes. However, the programme committee turned out not yet to have a full insight into the programme as a whole.

The programme management informed the panel to have the intention to evaluate all courses on their contribution to the biobased and interdisciplinary approach, including the newly developed ones which already ran as a pilot. In doing so, the programme will be assisted by the university's educational support service. The panel recommends the programme management to pursue this further in the near future in close cooperation with the programme committee.

Conclusion

The programme partially meets standard 2.

4.3 Standard 3: Assessment

The programme has an adequate system of student assessment in place.

Outline of findings

In the application document the use of various forms of assessment is specified: written examinations; products like papers, essays, reports and posters, and case-study assessments. The documentation also states that working with case studies and projects facilitates the combination of theory and practice as well as interdisciplinarity within the disciplinary specializations. The panel had a guided tour during which some students presented their project posters. The students explained that in these projects, they also paid attention to aspects from other disciplines. In addition to the poster, a disciplinary written exam is part of the final assessment of the course involved. Nevertheless they experienced these courses as mostly disciplinary.

Assessments will be organised and realised according to the WUR⁷ structure and regulations including those regarding quality assurance of testing and assessment. This implies that the programme committee (instead of the examination committee) monitors the relation between learning outcomes and assessments in order to develop an overall assessment strategy for the programme. The scheme discussed earlier (see standard 2) functions as such. Every course should have its own course objectives and assessment strategy. In the course descriptions the panel did find course objectives but no assessment strategies at course level. Also, the minimum requirements for passing an examination were not always clear.

During the site visit the panel studied two examples of course assessments, one of the course on Sustainability analysis and the other of the Biorefinery course. The assessment dossier of Sustainability analysis includes the assessment, the answer model and an assessment grid indicating how and where the course objectives are addressed in each of the assessment tasks. The assessment of the bachelor course on Biorefinery was presented as an example for the assessment. It appeared to be no more than four independent examination parts made by different lecturers and put together without any grid or answer model. The programme management commented on request of the panel about this situation that the Biorefinery assessment shown is of another degree programme, with a multidisciplinary character. Especially since the requirements for

⁷ The WUR has four examination committees for groups of programmes and a central assessment policy

passing this examination only holds a threshold for the total amount of points achieved, this provides the possibility that a student might fail for one of the independent examination parts, though still pass the exam. As such this examination fails to achieve the assessment of the multidisciplinary. Moreover, it underlined for the panel the need for explicit attention for the interdisciplinary approach in the assessments. Taking into account the interdisciplinary ambitions of the programme, one would expect more integration in assessments, for instance by presenting an interdisciplinary problem. The panel advised to take this into account when developing the assessment for the master course.

Upon asking how ACT, the internships and the theses will be assessed, the panel received some rubrics and assessment forms. These rubrics have in common that they have similar criteria and seem to be intended to be used throughout the WUR. They furthermore show that, when appropriate, external supervisors or commissioners are involved, for example in the assessment of internships and ACT projects. The panel did not find criteria for assessing interdisciplinarity in the rubrics or assessment forms.

The panel discussed these findings from documents with the programme management and the examination committee focussing on the missing assessment of interdisciplinarity in the exams and rubrics, exemplified in the biorefinery assessment. Both indicated that the assessment forms for the thesis are about to be adjusted to the new program biobased sciences.

When asked, the representatives of the examination committee said that they intend to assess more in a multi- and interdisciplinary way. At this point, they could not give an example of such an assessment yet. However, they did inform the panel how they would monitor the quality and alignment of assessments in practice⁸ by regularly visiting chair groups to discuss assessments and examinations. The panel had a good impression of the general policy on the quality of assessment and how the examination committee will fulfil its role professionally.

The programme management recognised the panel's concerns. In this context they refer to the crossing borders programme of the WUR, which aims for sharing expertise on integral and interdisciplinary testing and assessment. They expect that this will turn out to be helpful for this degree programme. Furthermore the programme is brought under the responsibility of the examination committee on technology and nutrition, which already has a member with specific expertise on testing and assessment.

Considerations

At first, the panel had confidence in the organisation of testing and assessment for the programme, as the WUR is known for its clear and effective organisation and practice in this respect. However, during the site visit it became increasingly clear that interdisciplinary testing and assessment so far did not receive the attention it deserves specifically for this programme. Also the panel noticed that not all courses comply with the WUR rules for testing and assessment, for example as alignment and assessment grids are concerned. Having met representatives of the examination committee, the panel wonders whether the current examination committee will be able to sufficiently encourage the programme in adequate testing and assessing the interdisciplinary elements of biobased sciences. The panel welcomes the explicit expertise on testing and assessment in the examination committee and suggests to appoint an additional member from within the programme.

The practice of using rubrics for assessing ACT, internships and the thesis is a good one, also from the perspective of feedback and feed forward for students, but the panel missed criteria regarding

⁸ The annual report of the examination committee mentions the necessity of better arguing the assessment results of theses and the intention to increase involvement of an expert in testing and assessment in monitoring the quality of testing and assessing courses as well as to pay more attention to monitoring the quality of testing and assessment at the level of programmes in close cooperation with programme managers.

the interdisciplinary biobased sciences approach. As the new program consists only of a limited number of new courses specifically addressing interdisciplinarity, the overall objectives of the new program heavily rely on the performance in the ACT, internship and thesis project, hence assessment on elements of interdisciplinarity, integration and systems approaches is very important. Therefore, the panel strongly recommends to adjust assessment forms. The panel appreciates that this process already started for some assessment forms.

Conclusion

The programme partially meets standard 3.

4.4 Qualification and field of study (CROHO)

The panel supports the program's preference for the CROHO field of study agriculture and natural environment.

4.5 Conclusion

The panel concludes that the master programme on Biobased Sciences offered by Wageningen University meets one out of three standards fully. The other two standards are met partially, but the panel has confidence that the programme will be able to fulfil conditions to meet these standards fully within a reasonable period of time. Therefore the quality of the programme is assessed as conditionally positive.

The conditions are:

1. Define and specify interdisciplinarity and multidisciplinary.
2. Include interdisciplinarity in the learning outcomes, criteria and assessments.
For example, pay more attention to chain and systems thinking, climate and environmental impact assessments, social impact analysis, supply chain management, policy developments, economic feasibility, (risk) perception and communication.
3. Adapt (existing) courses to more explicit inclusion of interdisciplinarity in the learning outcomes.
4. Provide a better foundation of interdisciplinary approaches in the programme to ensure a broadened and extended interdisciplinary basis in the programme for all students (independent from the specialisations they choose).
5. Include academic level elements with appropriate learning outcomes and assessments for all students on a) ethics and philosophy related to biobased sciences and transition paths; and b) societal aspects of biobased sciences & innovation.

5 Assessment of the Programme Extension

The panel assessed the request of the institution for the extension of the programme according to the Protocol for programme extension of 8 October 2003.

In the assessment of applications for programme extension, NVAO primarily focuses on the question whether the programme demonstrably requires extension of the curriculum in order to meet one or both of the criteria below:

- attaining the exit level desired from an international perspective;
- attaining the exit level based on the requirements of the professional field.

Criterion 1: Exit level from an international perspective

When the bachelors and masters were introduced in the Netherlands, technical academic programmes, leading to the title *ir* (ingenieur) were set at a duration of five years (300 EC; three years bachelor; two years master) in order to allow the students to attain an internationally comparable level. The international standard for the programmes was five years. Offering an education of four years, implying a one-year master's programme, would have put graduates of Dutch programmes in an unfavourable position compared to their peers abroad, regarding the knowledge and skills they would have acquired.

The learning outcomes of the programme are at a level that is comparable with those of similar international programmes⁹. The programme demonstrated that it aims for specialisation and interdisciplinarity as well as for a solid scientific focus with practice oriented components. According to the panel this requires, additional to the theoretical education and training an internship with a workload of (at least) 24 EC.

Criterion 2: Exit level to meet requirements from the professional field.

The learning outcomes to be attained by the students should enable them to compete in the professional field on an equal basis with their peers from other countries. Therefore they will have mastered substantial disciplinary expertise in one of the specialisations¹⁰ as well as interdisciplinary expertise on biobased sciences. Moreover, and representatives of the professional field emphasised this, students not only should have obtained in depth disciplinary knowledge, including the various methodologies, the relations between disciplines and their interdisciplinary integration, but also ought to have acquired research skills, communication skills, practical lab skills and business skills. As the programme is interdisciplinary, the thesis should be the result of an in-depth disciplinary study with substantial attention to interdisciplinary aspects, having a work load of at least 36 EC.

The panel is convinced that these arguments are valid. It therefore agrees that the programme needs two years to cover all the qualifications that graduates should master in order to be competitive on the international academic Biobased Sciences job market.

⁹ Like for example the MSc in Biorenewable systems at Pennsylvania State University and the MSc programmes in Bioeconomy and Biobased products & Bioenergy at Hohenheim University in Germany.

¹⁰ Biomass production and carbon capture, Biorefinery and conversion or Biobased and circular economy

6 Overview of the assessments

Standard	Assessment
<p>Intended Learning outcomes <i>Standard 1 : The intended learning outcomes tie in with the level and orientation of the programme; they are geared to the expectations of the professional field, the discipline, and international requirements</i></p>	Meets
<p>Teaching-learning environment <i>Standard 2 : The curriculum, the teaching-learning environment and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.</i></p>	Partially meets the standard
<p>Student assesment <i>Standard 3: The programme has an adequate system of student assesment in place.</i></p>	Partially meets the standard
<p>Conclusion</p>	Conditionally positive

Annex 1: Composition of the panel

Prof. dr. P. (Patricia) Osseweijer (*chair*), Professor Science Communication at Delft University of Technology, where she initiated the Section Biotechnology and Society at the Department of Biotechnology within the Faculty of Applied Sciences which she now leads. She has a MSc in Biology (molecular genetics and education) (Utrecht University) and a PhD in Science Communication (VU Amsterdam). After several functions at Radboud University Nijmegen in education program management and study advice she became executive secretary for the Department of Biotechnology in Delft. In 2002 she became managing Director of the national Kluyver Centre for genomics of industrial fermentation. This was joined with a function as Principal Investigator and member of the Management Team at the Centre for Society and Genomics. Presently she chairs the programs 'Societal embedding of a Sustainable Biobased Society' and 'Economy, Sustainability and Policy' of the Public-Private Partnership BE-Basic and is ambassador for global engagement with Brazil for the TU Delft. Her research group focusses on designing sustainable biobased value chains, responsible research innovation and communication. In 2015 she was awarded the Royal Academy of the Netherlands distinguished Lorentz fellowship for integrating social sciences and technology.

She has published circa hundred articles, and delivered more than eighty (invited) conference presentations. Osseweijer's outreach activities include the "Imagine" science communication project for secondary schools.

Prof. dr. M.J.E.C. (Marc) van der Maarel, full professor in Aquatic Biotechnology and Bioproduct Technology, Engineering and Technology institute Groningen (ENTEG), University of Groningen. Obtained a MSc. in Applied Biology with specialization in applied microbiology and biochemistry at the Radboud University and a PhD degree in microbial physiology from the University of Groningen (1996). Junior university lecturer in microbial ecology, University of Groningen (1995-1999), senior research scientist and project manager at TNO Quality of Life (1999-2008), research manager and team leader AVEBE Food Innovation Center (2009-2011), honorary professor in Carbohydrate Bioprocessing at the University of Groningen (Sept.2006-Dec 2011). Published over 60 scientific papers and 10 patent families.

Dr. ir. A. P. H. (Annita) Westenbroek, director Dutch Biorefinery Cluster; Obtained a PhD 'Extrusion Pulping of Natural Fibres - Determination, Implementation and Verification of Constitutive Equations required for Modelling', University of Twente + WageningenUR and a Master Chemical Engineering, University of Twente, Specialisation: Industrial Processes and Products. Innovation director Royal VNP, responsible for the set-up of the research agenda for the Dutch Paper and Board industry; define the long-term quantitative ambitions; set up and coordination of 'Icon project teams and activities focussed on removing social, legal, financial and communicational hurdles leading to reaching the long term goals. Advisor in the Biobased Economy, Assist several companies and regions in their bio-based strategy. Cluster director at ISPT, Project coordinator of a European project focused on reaching 80% CO2 emission reduction in the European pulp and paper industry by applying Deep Eutectic Solvents for lignocellulose pulping.

Prof. dr. J.H. (Han) de Winde, full professor Industrial Microbial Biotechnology and vice dean at the Faculty of Science, Leiden University. Han obtained an MSc in organic chemistry and biochemistry at the Vrije Universiteit Amsterdam, and a PhD in molecular biology, University of Amsterdam. He was postdoc and assistant professor at the Catholic University of Leuven; principal scientist Microbial Genetics and Physiology, DSM Life Sciences RD&T while part-time chair of Industrial Genomics at Delft University of Technology. Since 2006 he was director, Department of

Biotechnology, Delft University of Technology, chair of Genetics and Genomics of Industrial Microorganisms and business director of the Kluyver Center for Genomics of Industrial Fermentation. From 2010 to 2017 he was vice chairman of the Chemistry Board of the Dutch National Science Foundation. Since 2013 he is vice-dean, Faculty of Sciences, Leiden University and chair of Industrial Biotechnology. Han de Winde is an expert in microbial molecular genetics and metabolic engineering, in the field of signal transduction and control of physiology, growth and development of bacteria, yeast and fungi. His expertise extends to implementation and development of Systems and Synthetic Biology in microbial strain and process improvement. He is author of over eightyfive scientific publications and of ten filed patents families.

M.J. (Menno) van Gameren (*student member*) Student bachelor Future Planet Studies University of Amsterdam. Former vice chair of the faculty's student council in the Faculty of Natural Sciences, Mathematics and Informatics.

Secretaries

Drs. Frank Wamelink (policy advisor NVAO, process coordinator)

Drs. Johanneke Braaksma (educational advisor OAKnet, external secretary)

Annex 2: Schedule of the site visit

The panel visited Wageningen University on 16 February 2018 as part of the external assessment procedure regarding the wo-master Biobased Sciences.

- 08.30 – 9.30 Meeting of the committee and study of documents (private)**
- 9.30 – 10.15 Session 1 – Program management and brief presentation.**
- Arnold Bregt* *Dean of Education WU*
Sonja Isken *Programme manager*
Harry Bitter *Professor Biobased Chemistry & Technology*
Anja Kuipers *Programme manager Plant*
Renzo Akkerman *Associate Professor Operations Research & Logistics*
- 10.30 – 11.15 Session 2 – Teaching staff**
- Luisa Trindade* *Associate professor Plant Breeding*
Ellen Slegers *Universitair Docent Operations Research & Logistics*
René Wijffels *Professor BioProcess Engineering*
Elinor Scott *Senior Lecturer Biobased Chemistry & Technology*
- 11:30 – 12:15 Session 3 – Tour Technology Hall, Biomass Production and Student projects**
- Jacco van Haveren* *Programme manager Biobased Chemicals*
Students
- 12.15 – 12.45 *Lunch panel and study of documents (private)*
- 12.45 – 13:15 Session 4 – Students (in English)**
- Arne Knippels* *student Management, Economics and Consumer studies*
Fons Janssen *student Biotechnologie*
Sara Cazzaniga *student Plantsciences*
- 13:15 – 13.45 Session 5 - Members of the examination committee (examencommissie) and the program committee (opleidingscommissie)**
- Jozef Linssen* *first secretary examination committee*
Carla Dullemeijer *second secretary examination committee*
Emiel Wubben *Associate professor Strategic Management, business administration*
- 14:15 - 15:00 Session 6 - Delegation representing the professional field**
- Hans Ridderikhoff* *Global Research & Technology Manager, Smart Materials, Croda Nederland BV*
Anker P. Sørensen *Vice President New Business Keygene*
Heleen Goorissen *Vice President Global R&D Corbion, Purac*
- 15.15 – 15:45 Session 7 – Program management, with attention to aspects that are still unclear**
- Arnold Bregt, Sonja Isken, Anja Kuipers, Renzo Akkerman.*
- 15:45 – 17.15 *Committee deliberations (private)*
- 17.15 Brief feedback by chairman of the committee**

Annex 3: Documents reviewed

Programme documents presented by the institution

- Information dossier
- Appendices to the information dossier:
 - . Results institutional audit
 - . Summary labour market research
 - . Description of specialisations: Biomass Production and Carbon Capture, Biorefinery and Conversion, Biobased and Circular Economy
 - . Overview of courses
 - . Learning outcomes versus courses
 - . Overview of core staff
 - . Programme management
 - . Target audience and entry requirements
 - . Education and examination regulations
 - . Thesis assessment form
- Macro efficiency report on the wo master Biobased Sciences of WUR

Documents made available during the site visit

- 3 ACT project reports (on Seaweed cultivation, Sustainable system to purify water using aquatic plants, and revival of flax in Twente)
- 1 report on ensuring sustainable biodiesel production
- 1 MSc thesis on biobased sectoral developments
- Literature and materials of 5 courses
- Assessments of 2 courses: sustainability analysis and biorefinery
- Rubrics and assessment forms for assessing internships, ACT and thesis
- Minutes of the advisory committee Biotechnology including discussion on the programme
- Education assessment policy of Wageningen University, 2017
- Annual report of examination committees of Wageningen University 2016-2017

Annex 4: List of abbreviations

ABM	Agent Based Modelling
ACT	Academic Consultancy Training
ba	bachelor
BSc	bachelor of science
EC	European Credit
GPA	grade point average
hbo	hoger beroepsonderwijs
LCA	life cycle analysis
ma	master
mooc	massive open online course
MSc	master of science
NVAO	Nederlands-Vlaamse Accreditatieorganisatie
UTQ	university teaching qualification
wo	wetenschappelijk onderwijs
WUR	Wageningen University & Research

The panel report was ordered by NVAO for the initial accreditation of the programme wo-master Biobased Sciences of Wageningen University.

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