



ASSESSMENT OF CONDITIONS • Advisory Report

WO-MASTER BIOBASED SCIENCES

WAGENINGEN UNIVERSITY

MARCH 2020



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Inhoud

1	Task of the panel.....	4
2	Realisations on each of the conditions	6
2.1	Define and specify interdisciplinarity and multidisciplinary.....	6
2.2	Learning line Interdisciplinarity	7
2.3	Embedding interdisciplinarity in courses.....	9
2.4	Validation and assessment of interdisciplinarity	10
2.5	Beyond interdisciplinarity: crossing societal boundaries.....	11
3	Conclusions	13



1 Task of the panel

In 2018 (Decision dated: 31th of May 2018 -005914) the Accreditation Organisation of the Netherlands and Flanders (NVAO) decided to accredit the new wo-master Biobased Sciences at Wageningen University and Research (WUR) but imposed conditions to be met within two years. This was in line with the advice formulated and substantiated in the assessment report by the panel of experts.

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

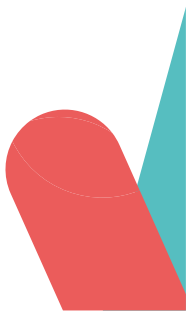
- a. Define and specify interdisciplinarity and multidisciplinaryity.
- b. Include interdisciplinarity in the learning outcomes, criteria and assessments. For example, pay more attention to chain and systems thinking, climate and environmental impact, social impact analysis, supply chain management, 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 programme delivered documentation of approaches to meet the conditions for accreditation on the 29th of November 2019 to the NVAO. The NVAO invited the complete panel of 2018 to participate in the assessment of this documentation to determine if the conditions were met. The panel-members agreed on participating again in this assessment. Only the student-member was unable to participate due to other obligations. A well experienced student-member replaced him.

The panel is asked to advise the NVAO board on the question whether the programme convincingly demonstrates that the conditions are now sufficiently met.

The panel carried out a brief site-visit on the 19th of February 2020 to discuss the dossier with the management, lecturers and students involved with the programme (see appendix 1 for the schedule of the day). Also a collection of teaching materials and examinations were made available to the panel in the programme's learning management system Brightspace. A draft report by the secretary was commented upon by all panel members. The chair edited an finalized this draft version which was send for approval to the panel members on the 26th of March 2020.

At the time of panel review, 63 students were enrolled in the Biobased Sciences MSc programme, 15 and 48 started in 2018 and 2019, respectively. Thus the panel could study how the programme is designed and adapted, delivered and evaluated by students.



Findings of the panel result from observations of the actual execution of the programme, teaching materials, assessments and project reports and dialogues with the lecturers.

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:

- Wietske Rem is Student: MSc Mechanical Engineering at University of Twente, Enschede (NL)

The panel is of the same composition as the panel during the initial assessment leading to the conditions. Wietske Rem replaced Menno van Gameren who was student member during the initial assessment.

The panel discusses its finding and conclusions for each of the conditions in the following text. In the overall conclusion the achievements on each of the conditions are considered.



2 Realisations on each of the conditions

2.1 Define and specify interdisciplinarity and multidisciplinary.

The programme brings together three domains of expertise: 1. Biomass production and carbon capture; 2. Biorefinery and conversion and 3. Biobased and circular economy. In each of these domains several disciplines are involved in the programme. A broad range of chair groups at WUR contributes to the programme.

The programme leaders argued that the multidisciplinary draws from different domains/disciplines. Students who are taught in a multidisciplinary way will learn to use approaches, techniques, methods from various disciplines and learn how to solve scientific questions or to design within different disciplines. They thus learn the internal logics of disciplines, and at the same time, by confronting these with other disciplinary logics, they learn to see the benefits and limitations of such an approach.

Students will follow modules in different disciplines and learn to use the different 'lenses' and will appreciate strengths and weaknesses of each of the approaches.

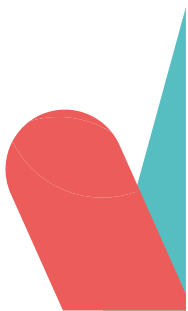
Interdisciplinarity is achieved '*when the synthesis of 2 or more disciplinary perspectives creates a new perspective, an analytical approach, or a solution that could not have been found otherwise*'. Students are asked to explicitly reflect on this additional value in several courses.

The programme presents several examples of multidisciplinary approaches and interdisciplinarity in the programme. Interdisciplinarity is included in the intended learning outcomes and the learning objectives of the courses (see 2, below).

Multidisciplinary and interdisciplinarity are distinguished by their level of integration: the first concept remains unintegrated; multidisciplinary results from disciplines A and B are indicated by: juxtaposing, sequencing, coordinating; the second concept is characterized by integrated interdisciplinarity results from disciplines A and B, indicated by: integrating, interacting, linking, focusing, blending.

Wageningen University and Research (WUR) has a longstanding track record in offering multidisciplinary and interdisciplinarity study programmes. In 2018, a university-wide Comenius Project was launched to map existing boundary crossing at Wageningen University and to improve and implement education on boundary crossing. This project on boundary crossing explores and highlights the importance of multidisciplinary, interdisciplinarity and transdisciplinarity at Wageningen University.

Inspired by this project and referring to relevant literature the Programme Committee agreed on clear definitions of these concepts. When the MSc Biobased Sciences programme refers to multidisciplinary or interdisciplinarity, the programme addresses combinations of different biobased disciplines and boundary crossing between those disciplines, respectively.



The panel appreciates the definitions of multidisciplinary and interdisciplinarity presented. It also acknowledges the tradition Wageningen has in this. The programme adaptations result now in a more dedicated focus for bringing together relevant disciplines to create a new perspective and added value on the theme of biobased sciences. The panel does caution however for a limited definition only focusing on 'added value' in case of interdisciplinarity. Interdependence of the contributing disciplines in the biobased chain is also an important aspect of interdisciplinarity which is not sufficiently considered. However, after the discussions with staff and students, the panel was reassured by the richness of the examples of how interdisciplinarity is presented, developed and reflected upon in the different courses and student projects.

The concepts of multidisciplinary and interdisciplinarity and their aim in the programme is now sufficiently presented in the programme outline and materials, but external comprehension could be strengthened by the development of a more complete description including the aspect of interdependency within the concept of interdisciplinarity.

2.2 Learning line Interdisciplinarity

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.

In the documents the programme argued that the learning outcomes now directly refer to interdisciplinarity. These are:

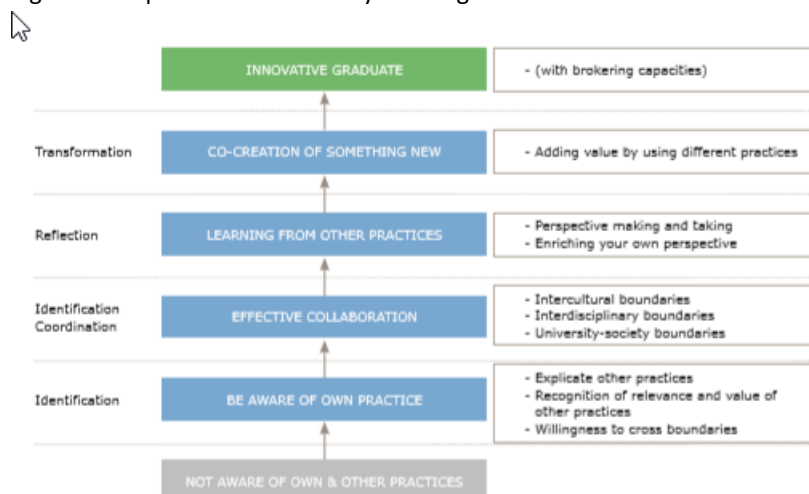
3. **cooperate in an interdisciplinary team** (including planning activities, assuming responsibilities and motivating co-workers) on a biobased-oriented research question, design problem, or development problem.
4. **assess technological, ethical, societal, and economic consequences of changes** in the design of a biobased concept, product, or production process, and integrate these into scientific work within an interdisciplinary and international context.
5. **Create additional value** by combining biobased disciplines, thus to apply an interdisciplinary approach.

The learning line on interdisciplinarity in the curriculum is strengthened in which these intended learning outcomes are subject of teaching, development by the student and assessment.

Interdisciplinary skills are developed in steps. Visualisation of these steps were developed in the institution wide Boundary crossing project.



Figure 1: Steps towards boundary crossing skills.



In the documentation and the interviews the programme staff convincingly demonstrated that these steps are included in the curriculum design.

In the first year's course *Principals of Biobased Economy*, the students learn different biobased disciplines. A multidisciplinary perspective is achieved by juxtaposing these perspectives i.e., biomass production, conversion/technology and circular economy.

The course *Circular Economy* is a compulsory interdisciplinary first year master course where the students learn in multidisciplinary student teams.

In addition to standard examination, the students are asked to provide reflection papers which are explicitly assessed on multi- and interdisciplinary skills and understanding.

Assessment criteria are:

- Is the student appreciative to ideas from other teams/people?
- Stated learnings show understanding of 'other' disciplinary backgrounds?
- Is it explicitly stated what role various disciplines have in answering the research question?
- Is there an understanding and use of each other's discipline and domain?

The panel supports the plans to introduce a portfolio of four reflection papers in the different stages of the programme (see below for further explanation).

In the *ACT (Academic Consultancy Training)* the students work in international multidisciplinary teams and integrate disciplinary approaches.

During the Master *thesis* the students have to dedicate at least 20% to a different disciplinary approach and have to address the question of possible added value of combining disciplines. The panel advises to avoid an 'additional disciplinary aspect' to be taken into account in a separate task and / or thesis chapter, but advises to integrate the interdisciplinary aspect throughout the thesis work.

The combination of disciplinary perspectives in the curriculum courses demonstrate the programme is multidisciplinary in nature, but that the approach is to create interdisciplinary skills and knowledge, which is done with dedicated criteria and assessments. The committee appreciated the provided examples of lecturers on how this interdisciplinarity was shaped in

the courses. Upon questioning also the students confirmed they valued learning interdisciplinary skills and that they have to reflect on the value and the development of their own interdisciplinary skills in reflection papers.

The foundations of interdisciplinarity in the programme are strengthened.

2.3 Embedding interdisciplinarity in courses

Adapt (existing) courses to more explicit inclusion of interdisciplinarity in the learning outcomes.

The programme presents three strategies to embed interdisciplinarity into courses:

1. by offering students realistic biobased projects to experience interdisciplinarity in action;
2. by teaching courses by interdisciplinary role model teachers;
3. by asking students to reflect on the additional value created by blending disciplines and interdisciplinary work.

The programme management explained that in response to the previous assessment several measures were undertaken. All course coordinators have been asked to specify and strengthen the interdisciplinarity in their course. In each of the specialisation one or more interdisciplinary courses are identified and it is compulsory for students to include at least one in the specialisation programme.

Interdisciplinarity in the programme courses was also strengthened through evaluation and feedback of the courses by the Education and Learning Support (ELS) chair group. The definition of interdisciplinarity was collaboratively discussed at a lecturers' meeting and members of the chair group examined how interdisciplinarity was integrated in the courses, what could be improved, and how to make interdisciplinarity more explicit in the learning outcomes, activities, and assessment.

Convincing examples of embedding and improved interdisciplinarity in the courses were presented to the panel. Examples included: In 'Principles in Biobased Economy' the assessment strategy was adapted by giving more feedback on student case study presentations and by adding a written exam to assess multidisciplinary. In the Circular Economy course, interdisciplinarity is taught in student teams working on a biobased case study. Many courses teach interdisciplinarity in student team projects, inviting guest lecturers and/or offering excursions, and by asking students to reflect. In addition the lecturer team of the programme now includes at least one lecturer who functions as role model as a result of personal interdisciplinary experience.

The Academic Consultancy Training (ACT) was already valued as a good example of interdisciplinary teaching by the panel in the previous assessment. The cases students have to work on during this course are of an interdisciplinary nature. The panel studied teaching materials and Assignments on the Brightspace platform. The Academic Consultancy Training provides students the possibility to work in a team on a "real world" project for an external client. A large range of WUR studies participate in the ACT courses, thus students have the opportunity to work on projects in truly multidisciplinary teams.



The ACT project starts with writing a consultancy project proposal. The proposal has to be signed by the commissioner, who approves the intended product and the requested budget. Students build a dossier containing: Application letter, Expectation paper, Midterm reflection paper, Final reflection paper and Reflection forms.

As mentioned before, interdisciplinarity is embedded in the Master's thesis projects. Students spend at least 20% of their project time of a different disciplinary perspective and are asked to reflect on the added value. Guidance is provided by two supervisors from the two disciplines or one of the interdisciplinary role-models.

The panel applauds that lecturers collaborate in discussing, evaluating and adapting the interdisciplinary nature of research projects and courses. This underlines that interdisciplinarity will develop further and will be strengthened in the programme.

2.4 Validation and assessment of interdisciplinarity

The most important forms of assessment and evaluation of the learning outcomes related to interdisciplinarity were presented to the panel.

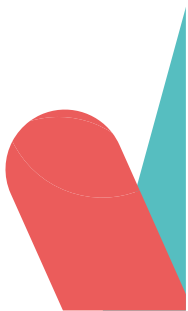
In the first year, students' interdisciplinary skills are assessed at both individual and group level. The student individually is asked to write reflection essays on the added value of combining disciplines. Examples are the reflection reports they write early on in Circular Economy and the products of the ACT courses.

As a future development a programme adaptation was presented: students will be asked to build a portfolio of four written reflection papers taken at four moments during their study as part of the regular programme courses (portfolio course). The programme committee suggested this possibility would strengthen the interdisciplinary learning line and individual development of an interdisciplinary perspective and the skill to perceive the added value of this perspective. The panel values this development. It studied some examples of the reflection papers handed in by current students in the Circular Economy course and found them in general meaningful.

The thesis includes interdisciplinarity. As a rule a minimum of 20% is presented from another disciplinary perspective. The Wageningen University-wide MSc thesis rubric has been extended since the previous assessment and now includes interdisciplinary reflection. The thesis project will always be guided and assessed by supervisors from different chair groups or by a role model supervisor who has interdisciplinarity as a skill.

Next year the programme will include the internship in the broad general part of the programme to strengthen the interdisciplinary approach of the internship. At this moment the internship is still part of the specialisation.

The study advisor has an important role in safeguarding the interdisciplinarity of individual study paths and specialisations. This is formalized in a contract with the student. In case the student develops an interest in a monodisciplinary specialisation the relocation to a monodisciplinary programme will be facilitated.



2.5 Beyond interdisciplinarity: crossing societal boundaries

In the documents the programme addressed under this heading the adaptations carried out to meet the conditions to include 1) ethics and philosophy related to biobased sciences and transition paths; and 2) societal aspects of biobased sciences & innovation.

The panel studied the courses and noted that this crossing of social boundaries and the ethical reflections are present in many courses and projects. The relevance of biobased sciences for society was addressed in the majority of projects that students carried out in their first year, as well as in their Academic Consultancy Training projects and thesis and internship projects.

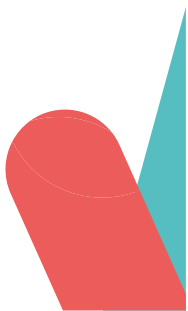
To ensure that all students develop the ability to cross boundaries towards society and ethics, this aspect will in the future also be included in the reflection reports assessed in the reflective portfolio course discussed above.

Lecturers presented convincing examples in the interview with the panel of intercultural and ethical issues discussed by the diverse student groups. Issues raised and discussions pursued showed however to be dependent on the background of students. This raised the question whether a specific international composition of the student group will be of influence on the quality and fruitfulness of the intercultural debate during the course. This should be assessed and improved to ensure that the qualifying learning outcomes for ethics and social aspects are reached since all students have to qualify in this domain.

A measure presented aimed at the strengthening of ethics and philosophy is the participation in the initiative to develop a new course on Data Science Ethics. This initiative is Wageningen University broad. The panel studied the first design and the learning goals of this course and discussed it with the management. The panel is not convinced that this course will add to the exploration of ethical issues related to biobased sciences, as biobased sciences is directly related to complex value chains with a multitude of different ethical issues. Furthermore, the course presented remains unrelated to the ethical discussion in the courses and it is scheduled too late in the programme to be of benefit to better structure (and analyse) the ethical issues in the various courses. It is scheduled after the courses in which a first understanding of the ethical issues would enable a deepening of the discussion based on specific cases and dilemmas the students are faced with in the group discussions, the projects and the reflections.

Hence the panel is not satisfied with the measures taken by the Programme Board to meet this condition: the proposed inclusion of ethics and philosophy is not enough dedicated to the specific challenges in biobased sciences and the related transition paths. The panel considered that the societal aspects of biobased sciences & innovation are sufficiently included in the courses.

In addition to the Data Science Ethics course the Institution-wide initiative to develop Responsibility as a course and include it in all programmes was presented during the interviews. This initiative is still in an early stage but would enable the programme Board to align the ethics and philosophy content much better with the biobased problems. The panel considers this as a promising initiative and suggests to further explore this path.



The panel was pleased to see the enthusiasm of students and lecturers. In particular the challenges that are made available to the students were noted, for example The Bio-based Innovation Student Challenge Europe (BISC-E) that encourages students to explore the emerging bio-based work field while developing a new bio-based product or process. Lecturers also showed their enthusiasm about the eagerness of the students to participate in such external challenges.



3 Conclusions

The programme presented measures to meet 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 panel is satisfied with the reformulation and clarification of the definition of multi- and interdisciplinarity (a). The process of definition is embedded in a broader discussion on interdisciplinarity within Wageningen University and Research (WUR); the boundary crossing project. The panel was convinced by the richness of the examples of how interdisciplinarity is presented, developed and reflected upon in the different courses and student projects (c).

Interdisciplinarity is sufficiently present in the programme but external comprehension could be strengthened by a completer description to reflect that is also refers to the interdependence in the domain of biobased sciences.

Interdisciplinarity is included in the learning outcomes, criteria and assessments (b). The programme convincingly demonstrates that the foundation for and learning line on interdisciplinarity is strengthened and that all individual study paths will include interdisciplinarity sufficiently (d).

Especially the thesis projects as explained by the students showed a substantial interdisciplinary approach. The guidance by two chair groups, the requirements and the examples given by the students show that the projects all realize relevant interdisciplinarity in the Biobased Sciences.

The panel was critical on the measures taken to meet the condition to 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 (e). Although good examples of ethical and societal discussions in the courses have been presented, the panel is not convinced that the Data Science Ethics course will add to the exploration of ethical issues related to the biobased value chain. It remains unrelated to the specific ethical discussion in biobased issues and it is scheduled too late in the programme.



The panel concludes that four out of five conditions are fully met (a-d). On the fifth condition (e) measures are taken but there still is need for additional thought and development, the panel advises to adapt the programme to include a dedicated course on ethics and philosophy related to biobased sciences and its value chains. Promising future developments have been presented to the panel and in general the programme appears to be a vehicle to develop interdisciplinarity in learning and research. Therefore the panel is confident that the conditions are sufficiently met to fulfil an urgent societal need to develop interdisciplinary scientists in biobased sciences.

Prof. dr. P. (Patricia) Osseweijer
Chair

drs. F. (Frank) Wamelink
Secretary



Appendix 1 Programme of the site-visit

M Biobased Sciences WUR 009156

Programme assessment conditions 19 februari 2020

Location: WUR Campus, Forum gebouw. VIProom 031

10.00 uur	Arrival
10.00-11.30 uur	Preparations of the panel: study of materials, formulating questions
11.30-12.00 uur	Programme management, brief presentation (5 minutes) and questions
12.00-12.30 uur	Course coordinators of courses contributing to interdisciplinarity
12.30-13.00 uur	Lunch discussion panel
13.00-13.30 uur	Students
13.30-15.00 uur	Discussion panel
15.00-15.15 uur	Brief conclusions panel
15.15 uur	End

