GEO-INFORMATION SCIENCE

WAGENINGEN UNIVERSITY AND RESEARCH

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This report was finalized on 9 November 2018.

REPORT ON THE MASTER'S PROGRAMME GEO-INFORMATION SCIENCE OF WAGENINGEN UNIVERSITY AND RESEARCH

This report takes the NVAO's Assessment Framework for Limited Programme Assessments as a starting point (September 2016).

ADMINISTRATIVE DATA REGARDING THE PROGRAMME

Master's programme Geo-Information Science

Name of the programme:	Geo-Information Science
CROHO number:	60108
Level of the programme:	master's
Orientation of the programme:	academic
Number of credits:	120 EC
Specializations or tracks:	-
Location(s):	Wageningen
Mode(s) of study:	full time
Language of instruction:	English
Expiration of accreditation:	31/12/2019

The visit of the assessment panel Geo-Information Science to Wageningen University and Research (WUR) took place on 25 and 26 June 2018.

ADMINISTRATIVE DATA REGARDING THE INSTITUTION

Name of the institution:	Wageningen University and Research
Status of the institution:	publicly funded institution
Result institutional quality assurance assessment:	positive

COMPOSITION OF THE ASSESSMENT PANEL

The NVAO has approved the composition of the panel on 24 April 2018. The panel that assessed the master's programme Geo-Information Science consisted of:

- Prof. dr. S. (Stanley) Brul (Chair), professor of Molecular Biology and Microbial Food Safety at the University of Amsterdam and chair of the Dutch Institute for Biology (NIBI).
- Dr. A.A.J. (Annik) Van Keer, educational advisor at the Faculty of Science at Utrecht University.
- Em. Prof. dr. A. (Anatoly) Gitelson, emeritus professor at the School of Natural Resources at the University of Nebraska-Lincoln (USA), visiting professor, Israel Institute of Technology.
- Prof. dr. H. (Henning) Sten Hansen, professor of Geographic Information at Aalborg University, founder and owner of DemoGrafix software (Denmark).
- S. (Sietske) Gadella, BSc (student-member), completed her bachelor's degree in Biomedical Sciences cum laude at Utrecht University in 2017.

The panel was supported by Dr. A. (Alexandra) Paffen, who acted as secretary.

WORKING METHOD OF THE ASSESSMENT PANEL

Preparation
In preparation for the site visit, the panel studied several documents: the NVAO assessment framework (2016), the institutional audit of WUR and the previous Geo-Information Science (MGI) programme assessment (from 2012). The accreditation system has entered its third phase (concurrently with a second round of institutional audits). Wageningen University and Research has recently successfully passed its second institutional audit. The new NVAO assessment framework is "geared to a quality assurance system that is based on trust in the existing, high quality of Dutch higher education".

In 2012 the MGI programme was assessed with an overall good score. The previous panel thought the programme had a "unique profile and objective" and that the intended learning outcomes were at the master's level and represented an academic orientation. The curriculum was "well-structured" and the teaching-learning environment clearly enabled students to achieve the intended learning outcomes. The panel was so impressed by the matrix the programme used - to show the link between assessment methods and intended learning outcomes - that it was "designated as a best practice". Finally, the quality of the theses was seen as "very good", and the graduates of the programme were "well prepared for jobs in research and in the professional field". The few recommendations that the previous panel made were picked up by the programme.

With the new philosophy of the framework and the last assessment of this specific programme in mind, the panel (of peers) does not want to elaborate too long on the different criteria of the four standards of the limited framework in this report. The overall evaluation of the programme is good, as it was in 2012. Therefore, the panel wants to concentrate on how the programme has developed since 2012 and where it can become even better than it already is.

QANU received the self-assessment report of the master's programme Geo-Information Science on 9 May 2018 and made it available to the panel. The panel members read it and prepared questions, comments and remarks prior to the site visit. The secretary collected these questions in a document and arranged them according to panel conversation and subject.

In addition, the panel members read recent theses from the master programme. In consultation with the chair, fifteen theses were selected from the academic years 2015-2016 and 2016-2017, covering the full range of marks given. The panel members also received the grades and the assessment forms filled out by the examiners and supervisors. An overview of all documents and theses reviewed by the panel is included in Appendix 5.

The project manager drafted a programme for the site visit. This was discussed with the chair of the panel and the policy officer. As requested by QANU, the programme management carefully selected discussion partners. A schedule of the programme for the site visit is included in Appendix 4.

Site visit
The site visit took place on 25 and 26 June 2018 at Wageningen University and Research (WUR). In a preparatory meeting on the day of the site visit, the panel members discussed their findings based on the self-assessment report and on the theses and formulated the questions and issues to be raised in the interviews with representatives of the programme and other stakeholders.

During the site visit, the panel studied a selection of documents provided by the programme management. They included course descriptions, course materials, written exams, assignments and other assessments.

The panel interviewed the programme management, students, alumni, staff members, members of the Programme Committee and members of the Examining Board.

After the final meeting with the management, the panel members extensively discussed their assessment of the programme and prepared a preliminary presentation of the findings. The site visit was concluded with a presentation of these preliminary findings by the chair.

Report
After the visit, the secretary produced a draft version of the report. She submitted the report to the panel members for comments. She processed corrections, remarks and suggestions for improvement provided by the panel members to produce the revised draft report. This was then sent to WUR to check for factual errors. The comments and suggestions provided by the programme management were discussed with the chair of the assessment panel and, where necessary, with the other panel members. After incorporating the panel's comments, the secretary compiled the final version of the report.

Definition of assessment standards
In accordance with the NVAO's Assessment framework for limited programme assessments, the panel used the following definitions for the assessment of both the standards and the programme as a whole.

Generic quality
The quality that, in an international perspective, may reasonably be expected from a higher education Associate Degree, Bachelor's or Master's programme.

Unsatisfactory
The programme does not meet the generic quality standard and shows shortcomings with respect to multiple aspects of the standard.

Satisfactory
The programme meets the generic quality standard across its entire spectrum.

Good
The programme systematically surpasses the generic quality standard.

Excellent
The programme systematically well surpasses the generic quality standard and is regarded as an international example.

SUMMARY JUDGEMENT

Master's programme Geo-Information Science

Standard 1
The panel thinks the current profile and objective relate very well to WUR's mission. Furthermore, the intended learning outcomes (ILOs) are well defined and structured and linked to the programme's profile and objective. They are geared towards the demands of the professional field. They are certainly of a master's level, and the programme has a strong academic orientation. Finally, there is a clear connection - within the programme - between theory and practice and thereby a good link with the professional field.

Standard 2
The Geo-Information Science (MGI) programme consists of modern, innovative, high-quality courses and a well-structured curriculum. There is a clear relationship between the ILOs and the objectives of the courses. The curriculum is structured yet flexible enough for students to design their own learning path. A lot of attention is also paid to real-world problems. There is a good connection with the professional field. The staff and study advisor are skilled and engaged. The teaching-learning environment is very good, which is facilitated by the fact that staff and students are all housed in one building.

The panel has the following recommendations to make: pay more attention to urban issues within the RS courses of the curriculum, make integrity issues more explicit within the curriculum, take measures to reduce study length, and organise more often educational seminars for its own community. Furthermore, it advises the programme management to keep a close eye on the quality of supervision given the growing number of students.

Standard 3
The panel finds that WUR has a good general assessment policy in place and that the MGI programme has a clear assessment plan. This plan is aligned with the general assessment policy. It applies different assessment methods that are aligned to the different learning outcomes. All learning outcomes are tested. There is a clear distinction between the assessment methods that are used and the complexity of the learning objectives. The course guide contains an assessment strategy for each course. The panel finds the assessments clear and transparent.

The panel believes that the Examining Board (EB) knows its legal duties and responsibilities. However, it feels the EB should visit the Chair Group(s) more frequently to execute its PDCA cycle. Some assessment procedures can also be professionalized and simplified by, for instance, digitalizing the assessment forms.

According to the panel, the overall thesis assessment and procedure are thorough and have strict regulations. The panel has a few comments to make concerning the assessment forms: the important skill and ILO communication deserves a higher weighting than 10%, it is not always clear from the forms who the first examiner is, and on several forms the mark was changed. By digitalizing the assessment forms, this last issue can be resolved. As with the thesis, the panel feels that a presentation of the research results should be part of the internship assessment.

Standard 4
According to the panel, all studied theses (15) are clearly final products of an academic master's degree programme and show that the students achieved the intended learning outcomes. In general, they are of high quality. The achieved learning outcomes of the programme connect excellently to the professional field, alumni feel very well prepared, and students and graduates are greatly sought after by employers.

General conclusion: the programme meets the standard

The panel assesses the standards from the *Assessment framework for limited programme assessments* in the following way:

Master's programme Geo-Information Science

Standard 1: Intended learning outcomes	good
Standard 2: Teaching-learning environment	good
Standard 3: Student assessment	satisfactory
Standard 4: Achieved learning outcomes	good
General conclusion	good

The chair, prof. dr. S. Brul, and the secretary of the panel, dr. A. Paffen, hereby declare that all panel members have studied this report and that they agree with the judgements laid down in it. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 9 November 2018

DESCRIPTION OF THE STANDARDS FROM THE ASSESSMENT FRAMEWORK FOR LIMITED FRAMEWORK ASSESSMENTS

Governance structure of Wageningen University and Research (WUR)
In contrast to many other Dutch Universities, WUR has just one faculty: the Faculty of Agricultural and Environmental Sciences. Therefore, the governance structure of WUR also differs from most other universities. The Rector Magnificus of the university is also the Dean of the Faculty. The Dean of the Faculty appoints the Programme Board, which consists of four professors and four students. The Programme Board is the legal governing body of the university's 18 BSc and 28 MSc degree programmes. The Programme Board is responsible for the design, content, quality and financing of the programmes.

Each programme has its own Programme Committee. A Programme Committee consists of an equal number of students and staff members who are appointed by the Programme Board. Programme Committees advise the Programme Board on the design and content of their degree programmes.

The Programme Board does not employ the lecturers (of the programme's courses); they are employed by one of the 94 Chair Groups. These generally include a Chair Holder (full professor), academic and support staff, postdocs and PhD students. The Programme Board, its Programme Committees, and the Chair Groups together form the WUR education matrix organization.

The Executive Board of WUR has appointed four Examining Boards (EB), each responsible for a group of related degree programmes (domain) and Chair Groups. Examining Boards are independent of the Programme Board and include staff members from the domain. They assess the individual study programmes of students and award degrees. They also appoint the course examiners and monitor changes to the assessment strategy of interim examinations in the annual education modification cycle. They ensure the quality of the interim examinations and, for that reason, periodically visit Chair Groups to discuss the validity and reliability of the assessments.

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.

Findings

Profile and objective
The two-year master's programme Geo-information Science (MGI) focuses on remote sensing (RS) techniques and the use of geographical information systems (GIS) to analyse and solve multidisciplinary issues related to complex spatial societal problems. Due to the focus of the programme on both RS and GIS topics, it has a unique identity and profile. No other master's programme within the Netherlands combines RS and GIS topics in this way. Also characteristic of this programme is the integration of a strong scientific approach with a practical approach, thereby developing methods, techniques and tools to address societal challenges regarding, for instance, deforestation, food security or biodiversity.

In the self-evaluation report, the objective of the programme is formulated as: "To educate graduates to become skilled geo-information scientists with the competences to analyse the usability of geo-information in complex spatial problems and to develop innovative and interdisciplinary solutions." This objective is in line with the vision and mission of WUR. Specific MGI examples include supporting decision-making processes in e.g. integrated land monitoring, food production and distribution, and analysing human-space interactions in complex urbanisation problems.

The panel greatly appreciates how the programme's profile ties in with WUR's mission. Furthermore, it is impressed by the programme's multidisciplinary approach, i.e. using RS and GIS techniques to solve environmental problems. During the site visit, it learned that an international benchmark was performed some six years ago. It was then established that the MGI programme has a unique identity. The panel agrees but would advise the programme to perform a new benchmark to take into account the changes and positive developments that the programme has gone through in the last years.

Intended learning outcomes, level and orientation
The above-mentioned objective of the programme has been translated into 12 intended learning outcomes (ILOs) (see appendix 2). They are linked to the Dublin descriptors for master's programmes. The ILOs are clustered: domain-specific knowledge about RS and GIS (ILOs 1-4), related scientific research qualifications (ILOs 5-7) and generic academic skills (ILOs 8-12). The master's level is emphasized in the ILOs, for example by paying specific and advanced attention to analysis, judgement, design and reflection. The panel found the ILOs to be well defined and structured and definitely of a master's level.

The orientation of the programme is academic. MGI graduates have learned how to critically evaluate geo-data, derive additional quantitative and qualitative information, and analyse, model and visualize the resulting geo-data. Research at WUR is conducted by Chair Groups. The main contributors are the two chair groups from the laboratory Geo-information Science and Remote Sensing (GRS).The following Chair Groups also contribute to the GIS programme: Information Technology, Soil Geography and Landscape, and Plant Production Systems. In this way students are exposed to state-of-the-art research. Along with the courses that are conducted by members of the Chair Groups, the thesis topics are also related to the research of the Chair Groups. According to the panel, they perform good research on how to use Geo-information Science to analyse, visualise, and model complex problems within environmental and agriculture sciences. The orientation of the programme is clearly academic.

Link with the professional field
As well as academic training, the programme is focussed on solving real-world problems. Students interact with scientists but also with stakeholders from various sectors (e.g. government, companies, NGOs) or specific communities (e.g. farmers, forest rangers or citizens). They are educated as engineers, researchers and consultants. The panel thought the link between theory and practice was indeed very strong in the programme. This is also reflected in the ILOs. The panel learned that this strong link between theory and practice is much appreciated by both students and alumni.

Since 2011 the programme has had an External Advisory Committee that advises the programme on what the professional field expects of MGI graduates and whether the ILOs are in line with the demands of the professional field. The programme management and the External Advisory Committee meet once a year. According to the self-evaluation report, the committee appreciates that MGI students can define their own learning path (ILO 12) and that they are capable of functioning in a multidisciplinary team (ILOs 8 and 9).

The panel applauds the programme for having established a committed and well-functioning External Advisory Committee. From the interviews held during the site visit, it is clear to the panel that there is a strong link between the programme and the professional field.

Considerations
The panel finds that the current profile and objective relate very well to WUR's mission. The ILOs are well defined and structured and linked to the programme's profile and objective. They are geared towards the demands of the professional field. They are certainly of a master's level, and the programme has a strong academic orientation. Finally, there is a clear connection - within the programme - between theory and practice and thereby a good link with the professional field.

Conclusion
Master's programme Geo-Information Science: the panel assesses Standard 1 as 'good'.

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.

Findings

Curriculum, content and design
The two-year programme offers a balanced range of courses from entry to advanced levels in the first year, enabling students to achieve the intended learning outcomes. There is a clear relationship between these learning outcomes and the courses. The second year of the programme consists of an academic internship (24EC) and a major research thesis (36EC). The programme is thesis oriented, and the curriculum design fits this approach. Students have to use and integrate the knowledge and competences learned in the first year in their thesis.

The first period of the first year contains a compulsory course *Geo-information Science in Context* to introduce the main concepts of the field (for a programme overview, see appendix 3). Group work and group activities (for example, field work) form a large part of this course. Attention is also paid to data security and ethics. Depending on their acquired knowledge and skills (or academic background), students choose Geo-information basic courses on Remote Sensing and/or Geo-information Tools. In the following periods, students can deepen their knowledge and skills by choosing at least one of three Geo-IT courses. Many students choose the *Geo-Scripting* course, which prepares them for a future professional role (in companies or research organisations) by focussing on the use of scripting languages for spatial analysis. In the fourth and fifth periods, students have to select at least two of three advanced courses: *Spatial Modelling and Statistics*, *Advanced Earth observation* and *Advanced Geo-information Science for Earth and Environment*. In the last period, all students have to follow the *Remote Sensing and GIS Integration* course, which enables them to practise academic consultancy skills in project teams. Real-world topics are provided by external commissioners such as research and governmental organisations or companies.

In contrast to the first year of the programme, the second year is dedicated to individual work: the *Major Research Thesis* (36EC) and the *Academic Internship* (24EC). The research subjects of the thesis are provided by the Chair Groups involved (see Standard 1) and are preferably related to the Chair Groups' research programmes. In this way students are part of and contribute to the Geo-information research domain. During the Academic Internship, students can participate in projects in organisations and work on real-world problems. They also become acquainted with possible professional career options within the Geo-domain. During the entire programme, students are encouraged to reflect on the role of Geo-information in societal and ethical debates regarding themes like data security, privacy and technological innovations (like robotics and drones).

The panel was impressed by the high quality of the programme. It finds the design of the curriculum to be modern and innovative and well-structured by building on prior learned knowledge and skills. The students are also very satisfied with the level and content of the courses, as concluded from student evaluations as well as the interviews with students held during the site visit. The panel advises the programme to make a link in the study handbook between the learning outcomes of the courses and the intended learning outcomes of the programme. It also believes that the programme could pay more attention to scientific integrity even though enough attention is paid to ethics in different courses.

The panel also appreciates the orientation of the programme to the professional field, while maintaining a research-based focus. For instance, through the implementation of more Geo-IT components in the last years and the focus on real-world topics, it connects very well with the demands of the professional field. The strong link between theory and practice is also recognised by both current students and alumni.

Before the site visit, the panel had some doubts about how the programme keeps up to date (with the rapidly changing new technologies, for instance). However, the staff and especially the students convinced the panel that they are able to keep up and demonstrated this. The panel was impressed to realise that the students' feedback was often an incentive for the programme management to innovate the curriculum (for instance, by adding courses like *Big Data* and *Machine Learning*). The panel learned from both students and alumni during the site visit that the programme management takes their feedback very seriously.

The panel also got the impression from the documents provided before the site visit that the focus of the programme (especially within Remote Sensing) was on agriculture and forestry and less on environmental sciences or urban sectors. This impression was confirmed in the interview with the students. The panel advises the programme to strengthen the already established collaboration with the Amsterdam Institute for Advanced Metropolitan Solutions (AMS). During the site visit, the programme management reassured the panel that, because of the growth in student numbers, it is hiring new staff. The new staff will have more urban-related expertise. The panel also had some preliminary concerns regarding the breadth of the programme. It was assured by both students and alumni that this breadth was much appreciated (and this was also confirmed by the staff).

Didactic approach
Except for the first introductory course (6EC) and last integration course (12EC) of the first year, students can design their own learning path. This is very much appreciated by both students and the External Advisory Committee. Given this flexibility, students can either specialise or broaden their scope.

The programme uses all sorts of new didactical approaches and teaching methods (such as flipping classrooms, peer review, etc.) and is looking for opportunities to use more online learning instruments (MOOCs with the AMS Institute, etc.). For the *Geo-Scripting* course, for example, all course materials are provided through an open source online platform. The course itself is made up of interactive sessions and practical sessions. The programme has also shifted its focus from more teacher-centred lecturing to more active and student-centred teaching methods. The first year is dominated by practical sessions (57%). For instance, as part of the final integration course, students work in a living lab environment to develop fieldwork skills. Of the contact hours, 11% is lectures, 15% group work, 5% fieldwork and 7% excursions. Group work is an important part of the programme, so students learn how to give each other feedback.

The panel noted from the documents presented and the interviews that the teaching-learning environment is of high quality, with a great variety of teaching methods and much attention being paid to project and teamwork. This is very much in line with the programme's learning objectives.

Staff and supervision
As already mentioned, the majority of the staff is part of the GRS chair groups. The staff members all hold a PhD and have a broad academic background within environmental sciences (from soil sciences to biosystems engineering). The multidisciplinary and interdisciplinary character of the ILOs is reflected in the diverse background of the staff. Some 72% of the current staff either has a University Teaching Qualification (UTQ) or is in the process of getting one.

From the student course evaluations, the National Student Survey and the student chapter (in the self-evaluation report), it is clear that the students are very satisfied with both the staff's knowledge and quality of teaching. The self-evaluation report also mentions that a number of staff

members have received award(s) for their teaching. With a staff:student ratio of 1:18 (lower than the university average), there is also regular interaction between students and staff. This informal contact with the teaching staff is very much appreciated by the students.

From the documentation presented and the impressions gained during the site visit, the panel is convinced of the quality of the staff and impressed by their engagement and involvement with the programme and its students. It does think that the management should stimulate all of their staff to make more use of the university sources available to professionalise and innovate their teaching skills, although this is university policy and may not really be something that the programme management can control. The panel observed that the additional budget for educational training is not completely used. The lecturers opting to participate in an educational seminar provided by the programme itself should be welcomed. The panel also thinks that WUR policy with regard to the staff getting an UTQ can be more ambitious.

From the documentation provided beforehand, the panel assumed that the growing student numbers might affect the hours spent on thesis supervision by the staff. It addressed this issue at length during the site visit and did not get the impression from the students and alumni that lack of supervision was a problem now. Future problems are being properly and proactively addressed by the management team, with the hiring of new staff.

Aside from the support offered by the teaching staff, the students can also rely on the study advisor, who guides them through their programme. The study advisor is a staff member of the GRS Chair Groups. During the first year there are no fewer than three consultation moments. The panel was very impressed by the engagement and amount of guidance the students of this programme receive from the study advisor. There is a potential conflict of interest if a staff member is also a study advisor, although it seems to be working well. In the case of severe personal problems, students are immediately redirected to an independent professional.

The panel did notice, however, that students spend more time (sometimes a lot more) completing their studies than the set number of two years. During the site visit, staff and management mentioned a lot of reasons for these delays. The panel was not convinced by their arguments and believes that the programme should make it clear from the beginning that the default is to finish the study programme within two years. It thinks that in this respect, specific attention should be paid to the supervision of especially the thesis (and maybe in some cases also the internship). It noticed among others from the theses it studied, that in too many cases a student does not finish his/her thesis on schedule.

Intake and teaching-learning environment
The students who enter the programme come from a diverse set of backgrounds, academically, culturally and professionally. Many students come from other European countries (one-third of the students are international). And a growing number of students come from other universities in the Netherlands or universities of applied sciences. In the first course, *Geo-information Science in Context*, the programme strives to bring students up to the same academic starting level. Furthermore, an active student community is fostered, and students exchange information about their background during this course. Depending on their academic background, students must then follow the Geo-information basics courses (see appendix 3). In the first compulsory GIS course, the programme stimulates students to share and exchange information. In the later compulsory GIS integration course, students form multi-cultural and multi-disciplinary project teams. This is an explicit objective of the programme that is also reflected in the ILOs.

The panel is very impressed by the way the programme embraces and enhances the diverse background of its student population. Furthermore, it applauds the programme for creating a truly international classroom. The fact that all facilities are in one building also creates a genuine community and constant exchange between staff and students. This very good teaching-learning

environment provides optimal conditions to enable students to achieve the ILOs, in the panel's opinion.

Considerations
The MGI programme consists of modern, innovative, high-quality courses and a well-structured curriculum. There is a clear relationship between the ILOs and the objectives of the courses. The curriculum is structured yet flexible enough for students to design their own learning path. A lot of attention is paid to real-world problems. There is a good connection with the professional field. The staff and study advisor are skilled and engaged. The teaching-learning environment is very good, which is facilitated by the fact that staff and students are all housed in one building.

The panel has the following recommendations to make: pay more attention to urban issues within the RS courses of the curriculum, make integrity issues more explicit within the curriculum, take measures to reduce study length, and organise more often educational seminars for its own community. Furthermore, it advises the programme management to keep a close eye on the quality of supervision given the growing number of students.

Conclusion
Master's programme Geo-Information Science: the panel assesses Standard 2 as 'good'.

Standard 3: Student assessment
The programme has an adequate system of student assessment in place.

Findings

General assessment policy
In 2017, WUR renewed its vision on education alongside its education assessment policy. This assessment policy defines why and how WUR assesses and how the roles and responsibilities are distributed. Its goal is to generalise assessment rules and policies and to make them transparent for both lecturers and students. In this policy, the learning outcomes of the degree programmes form the starting point. They are described for every programme and matched to the Dublin descriptors. In every programme WUR tries to create a clear relation between the ILOs and the learning outcomes of the courses, the teaching and learning activities, and the assessment.

The panel finds that WUR has a good general assessment policy and clear assessment plan. The MGI programme follows this general assessment policy and applies different assessment methods – assignments, project reports, oral presentations and performance evaluations - that are aligned to the different learning outcomes. All learning outcomes are tested. There is a clear distinction between the assessment methods that are being used and the complexity of the learning objectives. There is a course-dependent assessment strategy that is written down in a clear and transparent course guide. During the site visit, the panel learned from the Examining Board that it is satisfied with the quality of the assessment. The students told the panel that they thought the assessments were transparent and objective.

Examining Board
As mentioned at the beginning of the report, there are four Examining Boards (EB) at WUR, each responsible for the assurance of the quality of examination of a group of related degree programmes. The members are appointed by the Executive Board and at least one member is independent (not related to the degree programmes). For each course a member of the lecturing staff is appointed as examiner by the responsible EB. The examiner is responsible for the assessment strategy of the course(s).

The EB, accompanied by an assessment expert, tries to visit each Chair Group once every five years. It checks a sample of theses and internship assessments, and during the visit it discusses

the validity, reliability and transparency of the assessments (of the courses). When necessary, it proposes enhancements. In 2014, the GRS Chair Groups were visited. No irregularities with regard to assessments or the assessment practice were found.

The panel spoke at length with members of the EB during the site visit. It is clear that the EB knows its legal duties and responsibilities. However, the panel thinks the EB should visit the Chair Groups more frequently to execute its PDCA cycle. Although the EB sees the data (e.g. the evaluations of the examinations) annually, the panel feels there is too much distance between the EB and the degree programme. The EB told the panel that it lacks the resources to visit the Chair Groups more frequently, i.e. there is no teaching load allocated to their EB tasks. Therefore, their checking of the assessment system is limited to a focus on checks and balances. The EB said that they would like to have more time to invest in the quality of the assessment of the research projects. The panel advises the management of the MGI programme to think of ways to professionalize and thereby simplify some assessment procedures by, for instance, digitalizing the assessment forms and seeing to it that all theses go through the plagiarism system Turnitin.

Thesis and internship assessment
The EB checks every individual study programme of MGI students and evaluates whether it complies with the programme's ILOs. Before submission to the study programme approval system (SPA), the programmes are discussed by the student(s) and the study advisor.

The second year of the MGI programme is devoted to the thesis and the internship. The thesis is assessed in three stages: a go/no go advice (based on the thesis proposal after four weeks), a midterm presentation, and the overall thesis assessment at the end of the research project. A rubric is completed as part of the go/no go advice, which is also used during the final assessment. The midterm presentation is held in front of staff and other students, who provide feedback on the research design. At the end, a thesis examination committee, consisting of an independent assessor, the supervisor(s) and the examiner, assesses the overall quality of the thesis process, based on the thesis report, a final colloquium and an examination meeting. The thesis is assessed by four criteria: research competences 45%), thesis report (45%), oral presentation (5%) and defence (5%). These criteria can also be found on the thesis assessment form and rubric. Both are made transparent to the students.

The panel thinks the overall thesis assessment is very thorough, with strict regulations about the different roles to safeguard the assessment. What struck the panel was the rather low weighting of the oral presentation and defence (together 10%) as well as the weighting range, between 30% and 60%, of the thesis report on the general assessment forms. It feels that the important skill and ILO communication deserves a higher weighting than 10%, although it understood that this is university policy. It was glad to hear that for the MGI programme, the weighting of the report is fixed at 45%.

The panel studied several theses and their accompanying assessment forms. Overall it found the feedback on the forms clear and well-founded, and in general it agreed with the marks given. It thus thinks the assessment of the theses is valid. However, it is not always clear from the forms who is the first examiner, because the first examiner is called the second reviewer on the forms. More importantly, although it is clear that the examiner bears the final responsibility, the mark was changed on several forms. According to the panel, this can be easily solved by digitalizing the assessment forms.

Along with the thesis, the final year of the programme consists of an internship. The internship is supervised by both a university supervisor and a supervisor at the internship provider. The university supervisor visits the student twice at the internship location (or through meetings via Skype in case of an internship abroad). After three weeks students need to hand in an internship research proposal. As with the thesis, this proposal will be evaluated by the university supervisor, and a go/no go advice will be given.

The internship is assessed by three criteria/products: research competences (based on a scientific report on the research executed during the internship, weight 45%), internship report (45%) and self-reflection report (10%). Both supervisors assess the research competences and the internship report. The self-reflection report is evaluated by the university supervisor. An assessment form and rubric are available and provided to both supervisors and the student at the start of the internship. The appointed examiners take the final decision for approval of the internship assessment prepared by both supervisors.

The panel finds the procedures of the internship to be very solid and transparent. However, it wondered how a self-reflection report can be objectively graded. More importantly, there is a regrettable lack of a presentation of the research results of the internship. As with the thesis, the panel thinks that it is very important that a presentation of the research results forms part of the internship assessment.

Considerations
The panel finds that WUR has a good general assessment policy and that the MGI programme has a clear assessment plan. This plan is aligned to the general assessment policy. It applies different assessment methods that are matched to the different learning outcomes. All learning outcomes are tested. There is a clear distinction between the assessment methods used and the complexity of the learning objectives. The course guide contains an assessment strategy for each course. The panel judges the assessments to be clear and transparent.

The panel believes that the EB knows its legal duties and responsibilities. However, the EB should visit the Chair Groups more frequently to execute its PDCA cycle. Some assessment procedures could also be professionalized and simplified by, for instance, digitalizing the assessment forms.

According to the panel, the overall thesis assessment and procedure are thorough and have strict regulations. It has a few comments concerning the assessment forms: the important skill and ILO communication deserves a higher weighting than 10%, it is not always clear from the forms who the first examiner is, and on several forms the mark was changed. By digitalizing the assessment forms, this last issue can be resolved. As with the thesis, the panel feels that a presentation of the research results should be part of the internship assessment.

Conclusion
Master's programme Geo-Information Science: the panel assesses Standard 3 as 'satisfactory'.

Standard 4: Achieved learning outcomes
The programme demonstrates that the intended learning outcomes are achieved.

Findings
To review the achieved ILOs, the panel studied several documents and 15 theses and spoke with alumni. It agreed with the grading and considered the theses to be of remarkable quality overall and reflecting the ILOs well. The theses showed scientific depth, good analyses, critical discussion and the correct application of methods. All of the studied theses are final products of an academic master's degree programme and showed that the students had achieved the ILOs.

The panel also spoke at length with staff, students and alumni about the connection to the professional field. Students are thoroughly prepared for the professional field during the programme. This is achieved, for example, by implementing more Geo-IT components in the programme and incorporating real-world topics (offered by external commissioners or companies) in projects that students work on, and of course the experience that students gain during the internship.

Alumni of the programme are very satisfied and feel very well prepared for jobs both in and outside academia. The panel was very impressed by the excellent connection of the programme to the labour market. The job perspectives of this programme are clearly very good: for example, 55% of the graduates of the 2016-2017 cohort received a job offer from their internship provider. Most graduates end up in the Engineering and Consultancy sector, at research institutes or the university. Quite a few also find jobs in governmental organisations or the central government.

The panel would like to give the programme management one recommendation: put more effort into creating an alumni community by, for instance, organising return days.

Considerations
According to the panel, all of the theses studied (15) were final products of an academic master's degree programme and showed that the students had achieved the ILOs. In general, they are of high quality. The achieved learning outcomes of the programme connect excellently to the professional field, alumni feel very well prepared, and students and graduates are much sought after by employers.

Conclusion
Master's programme Geo-Information Science: the panel assesses Standard 4 as 'good''.

GENERAL CONCLUSION

According to the panel, the master's programme *Geo-Information Science* meets the standard and the NVAO criteria for re-accreditation. It was particularly impressed by the unique profile of the programme, the innovative curriculum, the generally high quality of the theses and the excellent connection with the professional field.

The panel assesses the *master's programme Geo-Information Science* as 'good'.

APPENDICES

APPENDIX 1: DOMAIN-SPECIFIC FRAMEWORK OF REFERENCE

Programme objective and profile

The Geo-information Science programme offers an academic curriculum on MSc level dedicated to the young and rapidly developing field of geo-information science. These developments are triggered by both technological and scientific developments. Society not only uses geo-located information; it is also a producer of (geo) data. The use of smart phones is a good illustration. They have turned into location-aware personal devices enabling geo-social networking, hardcopy maps are being replaced by flexible and living maps, and image displays with integrated navigational functionality and online search now easily pinpoint our current location. From a range of satellite and (unmanned) airborne remote sensing systems, spatially-continuous information can be derived at different scales on the Earth-system. As part of the geo-information science domain, efficient methods are being developed and evaluated to support societal challenges on monitoring and analysing environmental systems regarding land-use, deforestation, food-security and biodiversity. This also leads to an urgent need to analyse and model the integrated complexity of the spatial societal problems that are needed due to, for example, the world-wide process of increasing urbanisation.

The increasing complexity of our society leads to a demand for academic professionals who are able to renew and reflect on the acquisition, handling (or processing), presentation and management of geo-data using state-of-the-art theories, concepts, methods and tools. Therefore, the objective of the programme is: *To educate graduates to become skilled geo-information scientists with the competences to analyse the usability of geo-information in complex spatial problems and to develop innovative and interdisciplinary solutions.*

Geo-information has become an important societal commodity. Our graduates are able to critically evaluate this commodity and add value by deriving additional quantitative and qualitative information, and analysing, modelling and visualising the resulting geo-data. The programme focuses on geo-spatial problems in the context of the mission of Wageningen University: "to explore the potential of nature to improve the quality of life". Examples include supporting the decision-making process in environmental and agricultural management, integrated land monitoring, optimising food production and distribution and analysing changing human-space interactions in complex urbanisation problems.

The basis for the WUR programme was set in the beginning of the 1990s, around the same time the domain of geoinformation science was established. Over time, the programme has developed its unique identity, with in-depth courses combining both geographical information systems (GIS) and remote sensing topics, the opportunity to integrate courses on the Wageningen research themes "healthy food and living environment", and in the last six years, it includes a thorough basis for data science applications. Other programmes in this domain in the Netherlands are the MSc Geomatics at Delft University, characterised by a strong engineering and urban focus, and the MSc Geographical Information Management and Applications (GIMA) offered through the four universities of Delft, Utrecht, Twente and Wageningen. The latter programme has a more fixed and blended-learning based programme focussing on organisational and management aspects, and for example, less on remote sensing. The University of Twente has MSc programmes in this domain for foreign students (former ITC) but is now also preparing an MSc programme in Spatial Engineering open to Dutch students.

APPENDIX 2: INTENDED LEARNING OUTCOMES

Intended learning outcomes

The objective of the programme has been translated into the 12 intended learning outcomes (LOs). The table also links the learning outcomes to the Dublin descriptors to indicate the academic level of the master programme. The LOs reflect what students should know or be able to do after successfully completing the programme. A grouping is made into three specific clusters of LOs: domain specific knowledge and understanding regarding the domains geo-information science and remote sensing (LOs 1-4), scientific research qualifications in these domains (LOs 5-7) and development of generic

academic skills and attitudes (LOs 8-12). The LOs and their relationship with the Dublin descriptors have been defined after intensive discussions in the Programme Committee, with students and lecturers, and after consultation with the External Advisory Committee.

Intended learning outcomes (LO) ad relation to the Dublin descriptors

Grouping of LOs	After successful completion of this MSc programme graduates are expected to be able to:		Dublin descriptors
Domain specific knowledge and under-standing	1	Explain the basic theories, concepts and methods in the field of geo-information science and remote sensing.	Knowledge and understanding
	2	Apply geo-information science and remote sensing tools for the acquisition, storage, analysis, visualization and dissemination of spatial data.	Apply knowledge and understanding
	3	Investigate and judge the usability of geo-information in complex spatial problems in domains related to natural resources, living environment, food production and human society.	Apply knowledge and understanding Making judgements
	4	Create geo-information solutions for spatial problems in an interdisciplinary application domain.	Apply knowledge and understanding Making judgements
Research qualifications	5	Analyse concepts, approaches and methods and reflect upon scientific literature, with special reference to the field of geo-information science and remote sensing.	Apply knowledge and understanding Making judgements
	6	Design a research plan in the field of geo-information science and remote sensing by integrating adequate methods and techniques to collect, process and interpret data.	Apply knowledge and understanding Making judgements
	7	Carry out a study in the field of geo-information science and remote sensing and judge the quality for the different phases of the scientific research process.	Apply knowledge and understanding Making judgements
Generic academic skills and attitudes	8	Communicate clearly - both orally, in writing and visualisation - to present the outcomes of their research and design projects and discuss these results with specialists and non-specialists.	Communication
	9	Function effectively as specialist in international multidisciplinary teams with an active and critical attitude.	Apply knowledge and understanding Communication Learning skills
	10	Respond to social, organisational, scientific, multicultural and ethical issues that are encountered in the field of geo-information science and remote sensing.	Apply knowledge and understanding Making judgements
	11	Reflect critically on their results and performance, as well as on those of colleagues.	Making judgements Learning skills
	12	Design and plan their own learning processes through continuous reflection on and experiences gained in the domain of geo-information science and remote sensing.	Learning skills

APPENDIX 3: OVERVIEW OF THE CURRICULUM

Overview of MGI curriculum and course descriptions

The table below lists all courses of the curriculum, including course code, size in terms of credits, whether they are compulsory (CS) or restricted optional (RO), and scheduling (year, period). More details of each course can be found in the course description in the online study handbook of Wageningen University 2017-2018: https://ssc.wur.nl/Handbook/Programme/MGI
To view the description, select the link to a course from the list.

Course	Name	ECTS	Type[1]	Phase[2]
GRS-34306	Geo-information Science in Context	6	CS	M1
GRS-60312	Remote Sensing and GIS Integration	12	CS	M1
GRS-70424	MSc Internship Geo-information Science and Remote Sensing	24	CS	M2
GRS-80436	MSc Thesis Geo-information Science and Remote Sensing	36	CS	M2
GRS-20806	Geo-information Tools	6	RO0	M1
GRS-20306	Remote Sensing	6	RO0	M1
GRS-33306	Advanced Geo-information Science for Earth and Environment	6	RO1	M1
GRS-32306	Advanced Earth Observation	6	RO1	M1
GRS-30306	Spatial Modelling and Statistics	6	RO1	M1
INF-22306	Programming in Python	6	RO2	M1
GRS-33806	Geo Scripting	6	RO2	M1
INF-21306	Data Management	6	RO2	M1
ESA-20806	Principles of Environmental Sciences	6	RO3	M1
PPS-30306	Quantitative Analysis of Land Use Systems (QUALUS)	6	RO3	M1
CPT-21806	Communication and Policy Making	6	RO3	M1

1: CS = Compulsory courses; RO = Restricted optional; RO0 = Choose 0-2 courses, if these competences are not present according to the study adviser;
RO1 = Choose 2 courses; RO2 = Choose 1 course; RO3 = Choose preferentially at least 1 course in the field of the Wageningen UR domain

2: M1 = programme year 1; M2 = programme year 2

APPENDIX 4: PROGRAMME OF THE SITE VISIT

25 June 2018		
10.30	13.30	Arrival of panel, lunch, internal meeting and documentation review
13.30	14.25	Interview with management (including programme committee)
14.25	14.30	Mini break
14.30	15.15	Students
15.15	15.30	Break
15.30	16.15	Teaching staff
16.15	16.20	Mini Break
16.20	17.05	Examining Board and Study Adviser(s)
17.05	17.45	Alumni
17.45	18.15	Internal deliberation panel, short recap day 1

26 June 2018		
8.45	9.45	Arrival of panel, internal meeting and documentation review
9.45	10.30	Deliberations panel
10.30	11.15	Final interview with management
11.15	13.00	Deliberations panel and formulating preliminary findings and conclusions + Lunch
13.00	13.15	Feedback of preliminary findings and conclusions

APPENDIX 5: THESES AND DOCUMENTS STUDIED BY THE PANEL

Prior to the site visit, the panel studied 15 theses of the master's programme Geo-Information Science. Information on the selected theses is available from QANU upon request.

During the site visit, the panel studied, among other things, the following documents (partly as hard copies, partly via the institute's electronic learning environment):

1. Annual reports Examination Boards Wageningen University
2. Faculty Structure and Organisation
3. Education Assessment Policy, Vision, Practice and Quality Assurance, December 2017
4. Self-Evaluation Wageningen University Institutional Audit, 2018
5. Vision for Education, 2017, Wageningen University
6. Courses:
   GRS-34306 Geo-information Science in Context
   GRS-60312 Remote Sensing and GIS Integration
   GRS-20806 Geo-information Tools
   GRS-20306 Remote Sensing
   GRS-33306 Advanced Geo-information Science for Earth and Environment
   GRS-32306 Advanced Earth Observation
   GRS-30306 Spatial Modelling and Statistics
   INF-22306 Programming in Python
   GRS-33806 Geo Scripting
   INF-21306 Data Management