



Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Evaluation of Quality and Impact at SLU 2018



Evaluation of Quality and Impact at SLU (Q&I 2018)

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ABBREVIATIONS AND TERMS

EMA	Environmental Monitoring and Assessment (in Swedish Fortlöpande miljöanalys)
SLU	Swedish University of Agricultural Sciences
Q&I 2009	Quality and Impact 2009 research evaluation
Q&I 2018	Quality and Impact 2018 research evaluation
UoA	Unit of assessment, a group of researchers that have similar areas of science.
Review panels	The eleven areas of science to which UoAs belonged. Panels consisted of up to ten expert reviewers.
Expert reviewers	The 99 externally recruited persons with expertise in scientific quality, impact of research or collaboration with society that served on the review panels.
SLU Academic Management	Vice Chancellor, Pro Vice Chancellor, Deputy Vice Chancellors, and Deans of the four Faculties.
SLU Management	Vice Chancellor, Deputy Vice Chancellor, Pro Vice Chancellors, Head of University Administration and Assistant Head of Administration.

FOREWORD

University staff is more often than not subject to evaluations – PhD defences, recruitment procedures, peer-review of scientific publications, evaluations of grant proposals, etc. In many cases, it is the individual's performance that is evaluated.

However, no one is an island and the performance of the individual as well as of the university depends on creative and efficient collaborations within the university and with partners outside the university. Stakeholders, both regionally and nationally, expect SLU to generate sustainable and innovative solutions for the future. Furthermore, universities act in an international context and SLU's vision is to be a world-class university that attracts leading scientists, talented students and strong collaborators from across the world.

With these perspectives in mind, the Board of the University requested SLU to organize an evaluation of the quality and the societal impact of the university's research. The request, which came in April 2017, was timely also because an important component of the research-quality assurance system to be launched by the Swedish Higher Education Authority (UKÄ) will be based on universities' self-evaluations.

Already in 2009, SLU conducted an evaluation of the quality and impact of its research – Quality and Impact 2009. Quality and Impact 2018 drew on the previous experience in terms of the evaluation of the quality of research, but expanded and made a more thorough evaluation of SLU's societal impact. As in the previous evaluation, external experts, mainly from outside Sweden, reviewed self-evaluations, bibliometric and other data, and conducted interviews of staff from a number of Units of Assessment (UoA).

It is a challenging task to assess something as complex as research within a broader field at a university in another country. Our review panels took on the challenge very ambitiously and with great integrity.

Advice by critical friends is invaluable. Some of the points raised by the panels were known to us, but were more clearly formulated by the reviewers and carried the weight of being independent from the internal discussions. Other points raised introduced a new perspective and were novel. In both cases, we received constructive suggestions on how to improve.

The feedback from the panels was highly appreciated. There were the inevitable minor flaws, in most cases due to misunderstandings; however, they did not affect the overall quality of the reports. The university management received brief oral reports from all panels and comprehensive written reports with details about each UoA. This document presents an edited summary of the reports. Some comments and suggestions pertain to several organizational levels of the university and others are more relevant to a specific faculty, department or UoA.

Quality and Impact 2018 has provided time for self-reflection across the university and generated a rich selection of interesting ideas of vital importance for the future development of SLU. Now it is time to further contemplate what we have learned and take the actions necessary based on our new insights.

I sincerely thank our external reviewers for their great contributions. Many thanks also to the team coordinating the Quality and Impact 2018, staff responsible for delivery of data and service as panel hosts, and not least to the staff evaluated for the efforts they made.

Peter Högberg, Vice-Chancellor 2015–2018



SVENSK SAMMANFATTNING

SLU:s uppdrag är att utveckla kunskapen om de biologiska naturresurserna och hur dessa kan användas på ett hållbart sätt. För att uppdraget ska uppfyllas krävs att SLU:s forskning är av högsta kvalitet och att resultaten kommer till nytta i samhället. För att få insikt i hur vi arbetar mot dessa mål initierade SLU:s styrelse i april 2017 en forskningsutvärdering, Kvalitet och Nyttan 2018 (KoN 2018). I denna rapport beskrivs utvärderingens övergripande resultat, som kommer att utgöra en grund för framtida strategiska beslut på olika nivåer inom universitetet. KoN 2018 är den andra utvärderingen av sitt slag på SLU; den första genomfördes år 2009.

Utvärderingen fokuserade på forskargruppernivån och omfattade tre huvudkomponenter: 1) Forskningskvalitet, 2) Forskningens samhällsnytta och 3) Samverkansförmåga. De nästan 2 000 SLU-anställda som är verksamma inom forskningen grupperades i 61 bedömningsenheter ("Units of Assessment", här kallat forskargrupper). Forskargrupperna aggregerades i elva forskningsområden, som var och en motsvarades av en bedömarpanel. Varje panel bestod av upp till tio bedömare, sex med vetenskaplig expertis, en till två med expertis inom forskningens samhällseffekter och en till två med expertis inom samverkansprocesser. Som stöd för utvärderingen försågs granskarna med underlag i form av forskargruppernas självvärderingar, inklusive fallstudier inom samhällsnytta respektive samverkan med omgivande samhälle. Vidare fick de tillgång till bibliometriska analyser samt personal- och finansieringsdata. I slutet av maj 2018 besökte panelerna Uppsala för intervjuer och diskussion med representanter för de enskilda forskargrupperna. Detaljer om utvärderingens utformning beskrivs i kapitlet "Methods" i denna rapport.

Panelerna ombads att poängsätta tre bedömningskriterier för komponenten Forskningskvalitet (vetenskaplig kvalitet, vetenskaplig miljö och ledarskap, samt strategi för vetenskaplig utveckling) på en skala från ett till sex. De tre kriterierna för komponenten Samhällsnytta (aktiviteter, genomslag i samhället och strategi för nyttiggörande) poängsattes från ett till tre. För komponenten samverkansförmåga, som omfattade två kriterier (tillvägagångssätt och förståelse av samverkansprocessen), gavs skriftliga omdömen och rekommendationer men ingen poängsättning. Panelerna redovisade sin bedömning av varje forskargrupp i en skriftlig rapport, där de lyfte fram styrkor och svagheter samt gav förslag och rekommendationer om fortsatt utveckling.

I tillägg till bedömning av enskilda forskargrupper sammanfattade varje panel även sin övergripande syn på det aktuella forskningsområdet. De rapporterade också sina intryck muntligen till universitetsledningen. Vidare deltog 85 av de 99 bedömarna i en strategisk workshop med universitetsledningen, där de bidrog med individuella insikter och förslag rörande SLU som helhet. Resultaten från alla olika bedömningsmoment beskrivs och analyseras i kapitlen "Results and Analysis" och "Discussion" i denna rapport.

Utvärderingen visade att det inom vart och ett av de elva forskningsområdena vid SLU finns forskning av mycket hög internationell vetenskaplig standard, och vissa grupper klassas som världsledande. Flera forskargrupper fick högsta betyg även för vetenskaplig miljö och ledarskap, samt strategi för vetenskaplig utveckling. En analys visar på signifikanta statistiska samband mellan de tre bedömningskriterierna. Trots det goda helhetsresultatet ansåg panelerna att det finns utrymme för förbättringar. Exempelvis föreslog man att SLU-forskare i högre grad bör sikta på att publicera i tidskrifter med högre vetenskapligt genomslag, för att öka sin synlighet och sitt inflytande på vetenskapssamhället. Vidare skulle många

grupper vinna på att utveckla sina strategier för vetenskaplig utveckling. Ett ytterligare förslag gällde förstärkning av samhällsvetenskapen vid SLU för att förbättra förutsättningarna för forskare inom denna disciplin att samarbeta med naturvetenskapliga forskare på lika villkor. Panelerna betonade också att ökad rörlighet i form av forskningsbesök av seniora SLU-forskare vid internationella universitet skulle ge starkare nätverk och gynna den vetenskapliga kvaliteten på lång sikt.

Cirka 70 % av alla forskargrupper fick högsta betyg när det gäller att kommunicera sina forskningsresultat och att åstadkomma samhällsnytta. Ändå ansåg expertpanelerna att de flesta grupper skulle kunna utveckla sina strategier och arbetssätt för att få forskningsresultaten att komma till nytta i samhället. En analys av poängsättningen visar att det totalt sett inte fanns någon motsättning mellan vetenskaplig kvalitet och samhällsnytta. Många forskargrupper som arbetar med SLU:s unika uppdrag fortlöpande miljöanalys (Foma) fick höga betyg både för vetenskaplig kvalitet och samhällsnytta. Expertpanelerna framhöll att SLU:s många långtidsserier med data har stor potential både när det gäller samhällsnytta och vetenskapens möjligheter att angripa komplexa frågeställningar.

Såväl forskargruppernas egna underlag som expertpanelernas kommentarer gav värdefulla insikter i SLU:s förmåga att samverka med omgivande samhälle. Bedömarna såg tydliga potentiella fördelar med en ytterligare ökad samverkan mellan akademi och samhälle. I rapporten beskrivs fördelar och utmaningar kopplade till samverkan samt en analys av kritiska faktorer för ett framgångsrikt samverkansarbete. När det gäller spridning av forskningsresultat rekommenderade bedömarna att SLU utvecklar ett gemensamt koncept som kan göra universitetets uppdrag mer synligt och igenkänt. Begrepp som exempelvis "Hållbarhet" eller "Hållbart liv" kan uppmuntra forskargrupper från olika områden att bidra till helheten. En rekommendation för att öka SLU:s synlighet och attraktivitet för potentiella studenter var att använda FN:s Agenda 2030 och målen för hållbar utveckling som ett ramverk.

Bedömarna betonade den stora potentialen hos SLU:s framtidsplattformar – liksom andra tematiska plattformar – som verktyg för att öka det interna samarbetet och få fler forskare att engagera sig i tvärvetenskapligt samarbete. De flaggade också för att SLU bör arbeta med att ytterligare stärka det akademiska ledarskapet, förbättra rutinerna så att vakanser på ledande akademiska positioner undviks och se över om organisatoriska strukturer utgör hinder för tvärvetenskap.

En av de mest slående insikterna som bedömarna framförde vid den strategiska workshopen var att SLU sitter på ett "guldägg", tack vare forskningsområden som har avgörande betydelse för livet på jorden, världsledande kompetens och ett nära samarbete med intressenter, samt god forskningsinfrastruktur. Expertbedömarna ansåg att SLU är unikt i att ha tillgång till dessa resurser samtidigt och att kombinationen utgör en ovärderlig potential för SLU att bidra till en hållbar samhällsutveckling.

EXECUTIVE SUMMARY

The Swedish University of Agricultural Sciences' mandate to create knowledge on the sustainable use of natural resources demands not only that our research is of the highest international quality, but also that it comes to use in society. In order to gain insights into how we work toward these goals, the SLU University Board initiated the research evaluation Quality and Impact 2018 (Q&I 2018). The task was initiated in March 2017 and the written reports by external expert reviewers were submitted in June 2018. This report presents the key results that are to form the basis for future strategic decisions made by all levels of SLU. Q&I 2018 is the second evaluation of its kind at SLU; the first being conducted in the year 2009.

The focus of the evaluation was on the level of the research group and addressed three principal components: 1) the quality of their scientific research, 2) the societal impact of their research and 3) their capacity to collaborate with society. Nearly 2000 SLU employees working in research and research support were grouped into 61 Units of Assessment (UoAs).

SLU's research was divided for the evaluation into eleven areas, each of which corresponded to a review panel. Each panel had up to ten expert reviewers, six with scientific expertise, one or two with expertise on research impact, and one or two with expertise in collaborative processes. To facilitate the evaluation, external reviewers were provided with materials such as self-assessments written by research groups and included case studies of research impact and collaboration with society, bibliometric analyses, as well as staff and funding profiles. When they met in May 2018, representatives from the research groups and the expert reviewers had the opportunity to further discuss topics of importance. More details can be found in the Methods section of this report.

Expert reviewers were asked to score, from one to six, each of the three criteria for the component Quality of Research (Scientific Quality; Scientific Environment and Leadership; Strategy for Scientific Development). Each of the three criteria for the component Societal Impact of Research (Activities and Outputs, Outcomes, and Impact Strategy), was to receive a score from one to three. The criteria for the component Capacity for Collaboration with Society (Approach to Collaboration with Society; and The UoA's Understanding of the Process of Collaboration) were not assigned scores. The expert reviewers wrote comments, made suggestions, gave recommendations, and highlighted strengths and weaknesses for each research group in relation to each of the criteria above.

The expert reviewers gave insights into operations at several levels of the university. In addition to the reports for each research group (UoAs), they also described their overall view of the research field to which they belonged. They conveyed these findings to the University Management in a face-to-face discussion after interviews with their UoAs were concluded. In addition, 85 of the 99 expert reviewers participated in a strategic workshop with the University Management where they contributed with their own individual insights and perceptions of SLU. Each of these sets of results: on the level of the research group, on that of the research field, and on that of the university as a whole, made up the basis for the Results and Analyses, Discussion, and Recommendations sections of this report.

The results of the evaluation indicate that SLU has groups with “world-leading scientific quality” or “high international scientific quality” in each of the eleven research fields. With regard to the criteria Scientific Leadership and Strategy for Scientific Development, there are research groups within each field

that received the top scores of ‘exceptionally strong’ or ‘very strong’. There were significant correlations between each of these criteria. That is not to say that the expert reviewers did not have suggestions for improvement. One such was that SLU researchers could publish to a higher degree in renowned journals for increased/better scientific visibility and academic impact. Another was that many UoAs would benefit by exerting effort into strategic planning. Yet another suggestion was to strengthen the social sciences so that researchers from this discipline and those from the natural sciences could better collaborate on equal terms. They also stressed that increased mobility of senior researchers from SLU in the form of research visits to other universities would, in the long run, contribute to higher scientific quality and stronger networks for research.

About 70% of all UoAs achieved the top score for making their research known to society as well as for impacting society. Nonetheless, expert reviewers perceived that most groups could develop their strategic thinking and could plan ways to make their research results impact society positively. Overall there were no indications of a trade-off between scientific quality and societal impact. In fact, many of the research groups that work with SLU’s unique mandate on Environmental Monitoring and Assessment (EMA), received high scores for both quality of science and for societal impact. Additionally, the expert reviewers clearly stated that SLU’s many long-term databases have a vast potential for societal impact and for addressing complex issues with high scientific quality.

Research groups’ own descriptions and case studies of how they work to collaborate with society, and the expert reviewers comments on these, provided valuable insights into SLU’s capacity for collaboration with society outside academia. There was no doubt that the reviewers saw potential benefits from more collaboration between the academy and society. We report here keen observations into the benefits and the challenges of collaboration as well as the characteristics of successful collaboration.

More facts, comments and reflections on all of the results outlined above are found in the Results and Analysis as well as the Discussion sections.

Recommendations regarding the dissemination of SLU’s research results included adopting a common, shared perspective that makes SLU’s mission highly visible and recognizable. This could be for example “Sustainability” or “Sustainable Life”, allowing and encouraging many different research groups to contribute to the greater picture. A recommendation to increase SLU’s visibility and attractiveness for potential students was to better utilize the framework of the United Nations Agenda 2030 and the Sustainable Development Goals (SDGs).

The expert reviewers emphasized the potential of SLU’s Futures Platforms and other thematic platforms to function as facilitators for internal collaboration and the engagement of researchers in interdisciplinary sciences. They also flagged for improved academic leadership, better routines to avoid vacancies of leading academic positions, and to resolve organizational structures that might hinder interdisciplinarity.

One of the most striking perceptions revealed in discussions with external reviewers was that SLU has a ‘golden egg’. They point out that SLU’s core sciences are essential for life on earth, that SLU has world-leading expertise and close collaborations with stakeholders as well as good research infrastructures. The external reviewers considered SLU to be unique in having simultaneous access to these resources, and that the combination constitutes an invaluable potential for SLU to contribute to a sustainable societal development.

1 AIMS AND BACKGROUND

1.1 AIMS

The University Board of the Swedish University of Agricultural Sciences (SLU) decided in April 2017 to conduct an evaluation with three components: the quality of scientific research, the societal impact of SLU's research, as well as the capacity for research groups to collaborate with society. Focus for all components of the evaluation was to be on the level of the research group, which is termed here as the Unit of Assessment (UoA). SLU's Vice Chancellor appointed a project group to plan and implement the evaluation and to report the results to the University Board by the end of 2018.

The ultimate goal of the evaluation Quality and Impact 2018 was to increase the quality of SLU's research and thereby, with science-based knowledge, improve SLU's possibilities to impact society for the better. The evaluation aimed to identify the areas of research that are of outstanding scientific quality, and those that make positive contributions to society in general and to sectors relevant to SLU in particular. Areas of research that could be in need of revitalization and recommendations to achieve this were also in focus. The evaluation process in itself aimed to provide research groups with opportunities for the strategic discussions that are the essence of high-quality science and research impact on society.

Quality and Impact 2018 was explicitly an evaluation of SLU's research including research education. SLU's other two mandates; higher education, and environmental assessment and monitoring (EMA), are subject to separate evaluations and therefore were included only in relation to research. The results from Quality and Impact 2018 are to provide a basis for future strategic decisions made by all levels within SLU including the University Board, the SLU Academic Leadership, Heads of Departments, research groups and not least, individual researchers and educators.

1.2 BACKGROUND

In the last few decades, the progressive competitiveness in the international research landscape has led to a strong focus on assessment of research quality in terms of ranking systems, indicators such as bibliometric analysis of scientific quality, and evaluations based on peer review. Countries like the UK and the Netherlands have introduced national review models, with or without consequential funding. Since a national system for evaluation of research quality has been lacking, a number of Swedish universities and university colleges, starting with Uppsala University in 2007, have conducted their own research evaluations, with somewhat varying focus and scope. In 2014, the Swedish Research Council presented a proposal for a comprehensive national evaluation system, but opposition from the Swedish university community led to abolishment of the proposal by the government in 2016. Instead, the government has commissioned the Swedish Higher Education Authority (UKÄ) the responsibility for evaluating the Higher Education Institutions (HEI) systems for quality assurance of higher education and research on a national level. The objectives of UKÄ's national reviews are to assess the HEIs' systems for quality assurance and contribute to their work with quality improvement. The review model, currently covering education at all levels, will be extended in the near future to include quality assurance of research. The Quality and Impact 2018 evaluation, as part of a quality-assurance process, enables SLU to be well prepared to meet the requirements of the upcoming UKÄ review.

The Quality and Impact 2018 evaluation is the second evaluation of its kind at SLU, the first was

conducted in the year 2009 (Q&I 2009). The Q&I 2009 was composed of two separate, but concurrent, sections. The “Scientific Evaluation” section assessed research groups for scientific quality; recognition and leadership; relevance and impact; as well as strategy and potential. The ‘Impact and Utility’ section assessed how stakeholders perceived the quality of SLU. This focused not on the individual research group but rather on the level of the entire university. The 2009 assessment was completed by means of in-depth interviews with stakeholders and by a subject-oriented evaluation made by five thematic stakeholder panels. In addition, the Q&I 2009 evaluation included a separate segment on the area of Environmental Monitoring and Assessment (EMA). In Q&I 2018, EMA was an integral part of the scientific evaluation. Sources of inspiration for Q&I 2018, other than the Q&I 2009, are the Netherlands’ Standard Evaluation Protocol (SEP) and the United Kingdom’s Research Excellence Framework (REF) as well as Sweden’s Innovation Agency’s (Vinnova) work on indicators for societal impact, and capacity for collaboration. In recent years, Swedish research policy (e.g. the Research Bill in 2016) has shifted focus to appreciate the HEIs’ as more integral and influential components in society. Society expects research results to come more rapidly into use by stakeholders of all kinds. Expectations are high on the university sector to not only produce high quality basic and applied science, but also to contribute toward the betterment of such societal aspects as the economy, culture, public policy, environment and the quality of life. In order to address these expectations, one of the aims of Q&I 2018 was to gain insight into how SLU research groups work strategically to assure that their research results impact society. The construction of the evaluation allowed UoAs to show not only their academic outputs (scientific quality) but also their activities and outputs that are geared toward stakeholders outside of academia (societal impact). Specifically, they were to illustrate how these activities have resulted in outcomes that have led to positive impacts on society. In addition, research groups demonstrated with case studies how they collaborate with society in order to make this impact.

SLU is the first university in Sweden to conduct a research evaluation that formally links the results of research groups with their capacity to collaborate with society. Illuminating this link potentially allows for a better understanding of the benefits of and the prerequisites for successful collaboration between the academy and various stakeholders in society. SLU responds, in this evaluation, to the fact that the government as well as research funding agencies increasingly express the need for collaboration between academia and society. It also addresses the fact that since 2018, the allocation model for governmental funding includes the HEIs’ strategies for collaboration as a component. By including an assessment of capacity for collaboration in the Q&I 2018 allows SLU to be in line with, and even a step ahead of these recent national developments.

The Swedish government has since 1994 a national gender-equality policy which requires all public authorities to apply gender mainstreaming as a prioritized goal. All state-funded universities developed strategies to identify unequal career paths in academia, the need to work against gender-based educational choices and to improve student completion rates among both women and men. In accordance with SLU’s strategic direction document and action plan, gender mainstreaming discussions were an integral part of the entire planning process of the Q&I 2018 research evaluation. Links to these documents are found in the Appendix.

1.3 TIMELINE

Planning began in spring 2017 when SLU Management and Deans of the Faculties established the aims of the evaluation, and set guidelines for the operational aspects of the assessment. Research groups (UoAs) were identified in the early autumn of 2017 and subsequently review panels were formed.

Background information about the UoAs was compiled and made available on a digital platform in mid September 2017 when UoAs began writing their self-assessments. These self-assessments were submitted to the digital platform at the end of February 2018, and in early March, the expert reviewers gained access to the all information about each UoA. Chairs of the review panels met in Uppsala the first week of March to learn of the objectives of the evaluation and get instructions on how to lead the work within their review panel. In late May 2018, all the expert reviewers traveled to SLU Ultuna campus. The expert reviewers interviewed representatives of the UoAs in their panels on 29-31 May, and met shortly with SLU Leadership to give their views on the status of the general field of science in their panel on 31 May. Finally, expert reviewers participated in a strategic workshop on 1 June that was geared to give insights into the university as a whole. Review Panels submitted individual reports for their UoAs in early June, which after checking for factual errors, were made available to the UoAs and SLU Leadership in August. The University Board received an overview of the results on 17 December 2018 and this concise written report was published in early 2019.

TABLE 1. Timeline for the Quality and Impact Research Evaluation 2018.

Quality and Impact time line	2017												2018											
	April	May	June	July- aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec				
University board decision Quality and Impact 2018																								
Decision on Quality and Impact Leadership																								
61 UoAs defined																								
11 panels defined																								
Nomination of panel experts																								
Expert reviewers invited to serve on panels																								
Preparing criteria for the e valuation, self assessment templates and report templates																								
Bibliometric analyses, economic and personnel data compiled																								
Digital platform bibliometrics, economy and staff profiles open for UoAs information																								
UoAs work on self-assessments																								
Digital platform open for UoA t o submit their self-assessments																								
Panel chairs get briefing at SLU																								
Panel experts get all materials via digital platform																								
Panels interview UoAs at Ultuna campus																								
Panel reports submitted and fact checked by UoA																								
Reports compiled and made available on digital platform																								
Panel reports available to SLU																								
Results analysed																								
Quality and Impact report writing																								
Strategic work with the results																								
Final report to the SLU Board																								
Final report to stakeholders																					Jan-19			

2 METHODS

2.1 THE EVALUATION DESIGN

2.1.1 Units of Assessment (UoAs)

The Q&I 2018 had a research-group (UoA) perspective for all aspects of the evaluation. The basic units were to be strong, functional research groups. Heads of Departments in conjunction with the Faculty Deans lead the process in defining the UoAs. In total, 61 UoAs were formed of which fourteen included an entire department, whereas the others were parts of a department. A list of all UoAs is found in Appendix 1.

Units of assessment were to consist of not less than ten persons of which at least seven had obtained a PhD. Members of each UoA were all affiliated with only one department and one faculty. SLU has a number of departments that have two faculty affiliations and therefore some cross-departmental research groups that belonged to the same department, but different faculties, were evaluated separately.

The research evaluation was designed to include persons who have SLU as their main employer at present. For this reason, only SLU researchers and research staff employed by SLU at least 50% during the month of May 2017 were included. All PhD students and post-doctoral researchers, active during that same month, were included, regardless of how they were funded. Publications or research grants of persons employed less than 50% by SLU were included in the background data in those cases that they were joint ventures with UoA members. The UoAs also had the possibility to mention the contributions of these persons in the self-assessments.

A coordinator for each UoA was responsible for assembling the self-assessment and its timely submission. They also had responsibility for controlling the accuracy of the staff profiles for the unit and the economic data for the department.

2.1.2 Definition of research fields (review panels)

The evaluation was designed to reflect and highlight the current topics of research at SLU. For this reason, the UoAs were identified first and then the Deans of the Faculties and SLU Academic Management aggregated the UoAs into eleven research fields called review panels. Three of the panels consisted of UoAs from one faculty, four panels had UoAs from two faculties and the remaining four panels had UoAs from three faculties. The number of units assessed in the panels varied from four to nine and number of individuals per panel ranged from 93 to 311. Table 2.1.2 shows the eleven research fields, the number of UoAs, and the total number of persons who were evaluated in each panel.

2.1.3 Expert reviewers

Each of the eleven research fields, or review panels, had a group of up to ten expert reviewers who worked together to conduct the evaluation of the UoAs in their panel. The reviewers had expertise in at least one of the three aspects of the evaluation: quality of research (maximum six reviewers per panel), impact of research (one or two reviewers per panel), or research collaboration with society (one or two reviewers per panel). The majority of experts came from the academic community and the others came from relevant sectors that represent the needs of industry, governmental authorities, civil society (such as NGOs), and of society in general. Panel chairs, five women and six men, led the work of each review panel. In total 99 expert reviewers (45 women and 55 men) from 17 countries and 74 organizations

TABLE 2.1.2 Research areas, number of UoAs and number of persons evaluated in each panel.

Research Field	UoAs	Persons
Agricultural and Horticultural Production	4	110
Animal Health	5	167
Animal Science	6	185
Aquatic and Terrestrial Ecology	6	311
Economics, Business and anagement, and Statistics	5	93
Forest Management	4	191
Genetics, Molecular Biology and Physiology	6	226
Molecular Sciences, Biomaterials, and Technology	8	206
Nature and Society	9	211
Plant Protection	4	97
Soil and Environmental Sciences	4	119
Total	61	1916

convened in Uppsala from the evening of 28 May until midday on 1 June for the Quality and Impact 2018 research evaluation. A list of expert reviewers and their affiliations can be found in Appendix 2.

Heads of Departments and Deans of the Faculties who nominated expert reviewers after consultation with members of the UoAs initiated the selection of the expert reviewers. In order to assure the impartiality of potential reviewers, a set of criteria was established. Persons selected were not to have ongoing or recently concluded (within five years) collaboration with persons of a UoA in their panel. They were not to have more than two joint publications with UoA members. In addition, circumstances that could affect impartiality such as friendship or enmity with members of UoAs in their panel were not acceptable. In the same manner there was to be no connection with SLU that could affect the impartiality and outcome of the evaluation process. The few cases where expert reviewers had questions about potential conflicts of interest were solved in advance.

The group of expert reviewers in each panel were to conduct an evaluation in three steps: 1) Read and consider the self-assessments, bibliometric analyses, staff profiles and department financial profiles. Each expert reviewer was asked to make an individual preliminary score before arrival in Uppsala. 2) Interview representatives of the UoAs in their panels. 3) Write a report for each UoA. Their task was to complement the information gathered from the background materials mentioned above with their impressions from the interviews. The specific instructions to expert reviewers about the evaluation are found in Appendix 3.

2.2 BASIS FOR THE EVALUATION

The research evaluation was based upon

- self-assessments written by each UoA,
- staff profiles for each UoA,
- funding profiles for the departments to which each UoA belonged,
- bibliometric analyses,
- interviews conducted by the expert review panels with representative of each UoA.

All information concerning each UoA was accessible to the expert reviewers on the Quality and Impact 2018 Digital Platform from 1 March 2018. Interviews were conducted on 29 – 31 May.

2.2.1 Self assessment

Each UoA completed a self-assessment where they described their research and impact profiles. In total, UoAs answered 17 questions in the self-assessment. The quality of their research was the focus for ten questions, six questions were related to the societal impact of their research and one question was about their collaboration with society. In addition, UoAs submitted up to three case studies that described how research within the unit has led to societal impact. They also were asked to provide one case study that described a successful external collaboration and one that exemplified a less successful collaboration. The UoAs were given the opportunity to expand further upon their achievements in a section of the self-assessment called “Facts and Figures”. Here the UoA could profile its work in terms of scientific quality, research environments, faculty recruitment, research mobility and various types of interactions with society. The specific questions in the self-assessment form can be found in Appendix 4. While writing their self-assessments, the UoAs also had access to the report template that the expert reviewers would use to prepare their scoring and written report for each UoA. This evaluation report template is described in section 2.2.6.

2.2.2 Staff profiles

As a complement to the self-assessments, information was provided about the staff of each UoA. A staff list showed the name, employee category and age group of all persons included in the UoA. This included, for example, the number of full-time equivalents and percentage of staff for females and males in each employee category.

2.2.3 Funding overview

Financial information for the department to which each UoA belonged was provided for the year 2016 in the digital platform. In most cases the UoAs (47 of 61) constituted part of a department. Therefore, UoAs were given the possibility to comment on their own financial situation in relation to that of their department.

The funding overview included, among others, the amount and proportion of funding allocated to research, education, and environmental monitoring and assessment for the year 2016. It also showed the amount and the proportion of funding that came to the department during the years 2013–2016 through governmental allocation, commissioned research and research grants won in competition from research councils and foundations.

2.2.4 Bibliometric analyses

All publications produced by the UoA members were made available on the Q&I 2018 digital platform. Two types of bibliometric analyses were conducted; those based upon peer-reviewed publications and citations that were indexed in Web of Science during 2009 – 2015, and those based upon non-peer reviewed materials during 2012 – 2016 (reports, popular science articles, book chapters and books). The purpose of the analyses was twofold; to aid UoAs in the process of writing their self-assessment and to provide information to the Review panels on the quality and focus of the UoA’s scientific production.

Articles published in Web of Science-indexed journals were included in the citation-based analyses. An example of such is the “percentile profile” which shows the share of UoA’s articles that were among the most cited in their field of science (top 5%, top 10%, top 25%, top 50%). An article in the top 5% citation range is an indication of outstanding international quality and recognition. In addition to citation-based analyses, there were analyses based upon all types of publications by the UoA. These gave an indication of the popular science publications which, for example, mediates scientific information to the public.

Collaboration analyses provide an insight into the percent of peer-reviewed articles that have co-authors that come from at least two different affiliations. This indicator, together with the visualization showing co-publications between different UoAs and departments that are internal to SLU, as well as co-publications with national and international collaborating organizations gives a picture of the UoA’s research collaboration. Comprehensive information on all types of bibliometric analyses can be found in the Appendix 5.

2.2.5 Interviews

Expert reviewers interviewed representatives of their UoAs in order to complement the written documentation. Each UoA prepared a short presentation for their review panel and thereafter the expert reviewers asked questions and engaged them in dialogue. In the name of fairness, the number of persons in each UoA formed the basis for the length of time and the number of UoA representatives present at the interviews (Table 2.2.5). Each UoA determined who represented them at the interview.

TABLE 2.2.5 Scheme for number of persons, length of interview and length of UoA presentation at the Q&I 2018 interviews.

Persons in UoA	UoA representatives at interview	Length of interview	Length of presentation
5 – 10	3	1 hour	10 min
11 – 20	3	1 hr 15 min	10 min
21 – 39	4	1 hr 30 min	15 min
40 – 69	5	1 hr 45 min	20 min
70 – 92	6	2 hours	20 min

2.2.6 Research Evaluation Reports

The expert reviewers evaluated the UoAs in their panels by filling in an evaluation report. The report consisted of written responses to 14 questions related to research quality, societal impact of research, and the collaborative capacity of the UoA. The expert reviewers awarded numeric scores for scientific quality and societal impact of research. They also wrote a one-page overview of all the UoAs where they gave their observations and recommendations for the research field in general. The research evaluation report followed the same structure as that of the self-assessment that were submitted by the UoAs. The report template used by the review panels is found in Appendix 6.

2.3 EVALUATION OF QUALITY OF RESEARCH

The evaluation of quality of research in Q&I 2018 was similar to that of the previous evaluation Q&I 2009 in terms of the assessment of scientific quality, scientific leadership and strategy for scientific development. A difference is that in the 2009 evaluation certain aspects of the relevance and impact of

research were assessed as one of four criteria for quality of research. In the 2018 evaluation, the assessment of societal impact of the UoAs research was expanded and had its own separate set of criteria (see section 2.4).

Three criteria for Quality of Research:

- Scientific Quality
- Scientific Environment and Leadership
- Strategy for Scientific Development

The quality of research of each UoA was assessed and documented with written comments and recommendations and by means of a numeric score from one to six.

2.3.1 Scientific Quality

With regard to scientific quality, the UoAs described themselves and their work by writing in the self-assessment about such factors as their most important scientific achievements and by identifying research groups to which they compare themselves. Additionally they wrote about the strengths and weaknesses of the unit and described the factors that distinguish their research from other groups in their field of science. The expert reviewers in their evaluation report for each UoA, gave a score for and commented on matters such as the depth and breadth of the research profile, the originality of ideas, choice of research methods, the scientific productivity and the prominence of the UoA in their field of science. Expert reviewers in the panels also identified strong research and successful research constellations.

Scores for Scientific Quality:

- 6 - World-leading - *Original research that defines and shapes a research field.*
- 5 - High international - *Original research that substantially influences a research field.*
- 4 - Internationally recognized - *Research of quality that contributes to, but does not redefine a research field.*
- 3 - Moderate - *Research of some quality, but without significant impact on the research field.*
- 2 - Inadequate - *Research with a few strengths but also with major weaknesses.*
- 1 - Poor - *Research with few strengths and major weaknesses.*

2.3.2 Scientific Environment and Leadership

Expert reviewers were asked to give a score for and provide comments on the degree to which they had achieved, and how the UoA worked to maintain a creative and intellectually vigorous and productive research environment. Comments included, for example, levels of diversity, support to young faculty, gender balance, mobility, and the age balance within the units. They also considered the geographical scope of the academic networks and collaborations as well as aspects of interdisciplinarity of the UoA.

Scores for Scientific Environment and Leadership:

- 6 - Outstanding - *Exceptionally strong with negligible weakness.*
- 5 - Excellent - *Very strong with minor weaknesses.*
- 4 - Good - *Strong with minor weaknesses.*
- 3 - Moderate - *Some strengths but also with moderate weaknesses.*
- 2 - Inadequate - *A few strengths but at least one major weakness or several minor weaknesses.*
- 1 - Poor - *Very few strengths and numerous major weaknesses.*

2.3.3 Strategy for Scientific Development

In their self-assessments, the UoAs outlined their goals and strategies for promoting scientific quality and renewal for the coming five years. They identified challenges and what resources they would need to be able to implement the strategies. The panel experts gave in their reports a numeric score for the UoA's strategy for scientific development. They commented on the UoA's strategy for scientific renewal, how realistic their goals were, how the UoA were involved in the emerging directions within their field of science and the potential of the unit for making significant future contributions there. In addition, panels commented on the challenges that faced the UoA in terms of their forthcoming scientific development.

Scores for Strategy for Scientific Development:

- 6 - Outstanding – *Exceptionally strong with negligible weakness.*
- 5 - Excellent – *Very strong with minor weaknesses.*
- 4 - Good – *Strong with minor weaknesses.*
- 3 - Moderate – *Some strengths but also with moderate weaknesses.*
- 2 - Inadequate – *A few strengths but at least one major weakness or several minor weaknesses.*
- 1 - Poor – *Very few strengths and numerous major weaknesses.*

2.4 EVALUATION OF SOCIETAL IMPACT OF RESEARCH

Why is the societal impact of research an important criterion in a research evaluation? One aspect is that it gives a measure of the ability of the research group to identify and contribute to solving emerging issues that come up in discourse with stakeholders. Those issues can be the basis for highly relevant research questions and the results contribute to solving societal challenges. This process can create a loop of mutual benefit for research and for the stakeholders who use the results. The process of research results impacting society can be sketched with just a few steps. Starting from the context and content of the research results, the process requires the research group's engagement in activities that open dialogue with persons and organization that potentially could use the results. This in turn leads to knowledge, products and services (outputs) that are made available to these stakeholders. The subsequent step is when specific stakeholders, and society in general, use the research group's outputs/outcomes (products, services, expert advice for decision making, patents and the like). Finally, the actual impact of the research on society comes when these outputs and outcomes are proven to have contributed to change society for the better. Examples of the impact of research on society can include a change in environmental laws, effective diagnostics of veterinary diseases, contributions to EU directives, just to name a few.

The quality and Impact 2018 research evaluation has taken into account several factors that are important for research results to impact society.

The criteria for Societal Impact of Research

- Activities and Outputs
- Outcomes
- Impact Strategy

In order to conduct their evaluations on societal impact, expert reviewers had access to all the qualitative background materials and the self-assessments that the UoAs submitted. In addition, each UoA gave three case-study examples of how their research had led to societal impact. UoAs were awarded a score from one to three on each of the evaluation criterion above.

2.4.1 Activities and Outputs

In their self-assessments, UoAs listed their most important activities and outputs and identified the stakeholders with which they have collaborated during the most recent five years. In their reports, the expert reviewers considered if the full potential of the unit was realized in terms of activities and outputs, given the current research profile of the UoA. Examples of such outputs were how many and the range of different activities the UoA hosted or participated in, if and how the UoA members were active in societal debates, and whether their activities, publications, and interactions were relevant to their stakeholders and the general public.

Scores for Activities and Outputs

- 3 - Excellent – *Research activities and outputs with very high societal impact.*
- 2 - Good – *Research activities and outputs that have societal impact.*
- 1 - Inadequate – *Research activities and outputs that have no societal impact.*

2.4.2 Outcomes

UoAs in their self-assessments identified their key outcomes, that is to say, the concrete results of their activities and outputs. The expert reviewers gave a score for the UoA's outcomes and commented on if the full potential of the UoA was realized with regard to these.

Scores for Outcomes

- 3 - Excellent – *Research outcomes that have a very high societal impact.*
- 2 - Good – *Research outcomes that have societal impact.*
- 1 - Inadequate – *Research outcomes that have no societal impact.*

2.4.3 Impact Strategy

Units outlined in their self-assessments, the potential of their research to contribute to societal needs and solving challenges. They also identified their specific strategies to reach this potential. In addition, UoAs showed how they work to ensure that their research results are more readily adopted by society. The expert reviewers in their report gave a score for the UoA's impact strategy and commented on if the strategy was realistic given the UoA's research profile.

Scores for Impact Strategy

- 3 - Excellent – *Research impact strategy for very high societal impact.*
- 2 - Good – *Research impact strategy for societal impact.*
- 1 - Inadequate – *Research impact strategy lacking or has no societal impact.*

2.5 EVALUATION OF CAPACITY FOR COLLABORATION WITH SOCIETY

The purpose of assessing capacity for collaboration in this research evaluation is to identify our strengths and challenges as a foundation for future strategic initiatives to develop this capacity within the university, ultimately with the aim of enhancing scientific development and societal impact. The questions in the self-assessment about the capacity for collaboration with society that were posed to the UoAs, provided an opportunity to reflect, learn and not least, to promote awareness of how the collaborative process can contribute to the development of scientific quality.

SLU's definition of collaboration is: "*Collaboration is a means or a process that requires two or more parties to achieve a common goal that would not have been possible for them to achieve on their own*". This definition differs from the common use of the term in academia, which most often refers to the second paragraph of the Swedish Higher Education Act, which states: "*The mandate of higher education institutions shall include **third-stream activities** and the provision of information about their activities, as well as ensuring that benefit is derived from their research findings*". Third-stream activities (in Swedish – samverkan) here refer to interactions between universities and the rest of society. SLU's definition of third-stream activities specifically focuses on the interplay between actors in order to capture the beneficial potentials of collaboration, and less so on unidirectional information and ensuring that research findings comes to use.

The criteria for Capacity for Collaboration with Society were:

- The UoA's approach to collaboration with society
- The UoA's understanding of the process of collaboration

The Capacity for Collaboration with Society was not assessed with a numeric score. Instead, the expert review panels were asked to perform a context-dependent qualitative assessment for each UoA and to give constructive feedback about the UoA's approach to collaboration with society.

2.5.1 The UoA's approach to collaboration with society.

The UoAs in their self-assessments described their approach to collaboration with actors other than those in academia. They were asked to discuss the important factors in a collaborative process and if they found any benefits of collaborative endeavors for their research. Expert reviewers commented on the UoA's attitude toward collaboration and on their understanding of the collaborative process. They also gave their impressions about if the units understood the potential benefits of a collaborative approach to their scientific development.

2.5.2 The UoA's understanding of the actual process of collaboration.

The UoAs submitted two case studies, one outlining a successful collaboration and one that exemplified a less successful collaboration. Expert reviewers, in their reports, gave their impression of the UoA's understanding of the collaborative process. They also gave recommendations on how the unit could further develop their capacity to collaborate with actors outside the academic sector.

2.6 ORAL REPORTS FOR EACH RESEARCH FIELD

As a complement to the evaluation of individual units of assessment, the review panels shared with the SLU Academic Management their general observations and recommendations for the fields of research to which the UoAs belonged. In half-hour sessions on May 31 – 1 June, SLU's Academic Management listened to the insights that the panels had gathered during the Q&I 2018 process. Since these oral reports were conducted while the panel members still had their focus on SLU, the ensuing discussions were on a level of complexity that otherwise would not have been possible to reach. In addition, panels wrote a one-page report that outlined the strengths; weaknesses and the potential of the research field as a whole (see Appendix 7 for these overview reports). Here they also remarked on the use of research infrastructures and collaborations between UoAs in closely related research areas at SLU. Notes from these oral sessions together with the overview reports from the panels are some of the material upon which this Q&I 2018 report is based.

2.7 STRATEGIC WORKSHOP

On the first of June, expert reviewers from all review panels were invited to meet with the SLU Management, and the Faculty Deans, and share the insights they gained from interactions on different levels of organization at SLU. Because they had just completed the research review process, the reviewers had unique insights pertaining to the individual research groups (through the 61 UoA reports), and on the fields of science at SLU (through their oral panel reports/discussions with university leadership). They agreed to share their insights about the university as a whole within the framework of a strategic workshop. Topics for discussion were those that the panels had raised during the evaluation process. Other more general questions were raised such as: which are the most important issues that SLU should develop and which steps should be taken to address these issues in the short and the long run? Further questions were about identifying SLU's greatest challenges and opportunities.

The strategic workshop, developed by SLU's Group for Academic Leadership, was arranged so that SLU academic leaders were instructed to be active listeners, but not to participate in the round-table discussions. Members of the SLU staff that functioned as panel hosts took notes during the round table discussions. Finally, the SLU Management, and the Faculty Deans, were on stage to relate to the assembly of expert reviewers what they had heard during the round-table discussions. They also shared what surprised them and what they considered to be important insights from the workshop.

3 RESULTS AND ANALYSIS

3.1 QUALITY OF RESEARCH

3.1.1 Scientific Quality

This section focuses on the current situation of the UoA, as judged from its performance during the most recent years. The review panels were asked to comment on depth and breadth of the research profile, originality of ideas, choice of methods, scientific productivity, scientific impact, and prominence in the field of science.

General picture

Judged from the numeric scores, the general outcome is very positive (Fig. 3.1.1). Of the 61 UoAs in total, 28 (46%) were judged to be of “High international” or “World-leading standard” (i.e. a score of five or higher), while only six UoAs (10%) had a score of four or lower. This can be compared to the outcome in KoN 2009, where the corresponding figures were 32 % on both accounts. The proportion of UoAs judged to be “world-leading” was 8 %, as compared with 7 % in KoN 2009. However, since the composition of the UoAs was different in the two evaluations, the results are not directly comparable. In contrast to the previous evaluation, no UoAs in Q&I 2018 were graded as “inadequate” or “poor”. Further, the average score of 4.5 in Q&I 2018, was higher than the average of 3.9 in Q&I 2009. Although scoring between the two evaluations may not be directly comparable (e.g. other principles for forming UoAs, different review panels, and different reviewers involved) the results indicate that the overall scientific quality of research at SLU has improved since 2009. For scores of individual UoAs, see the Appendix 8.

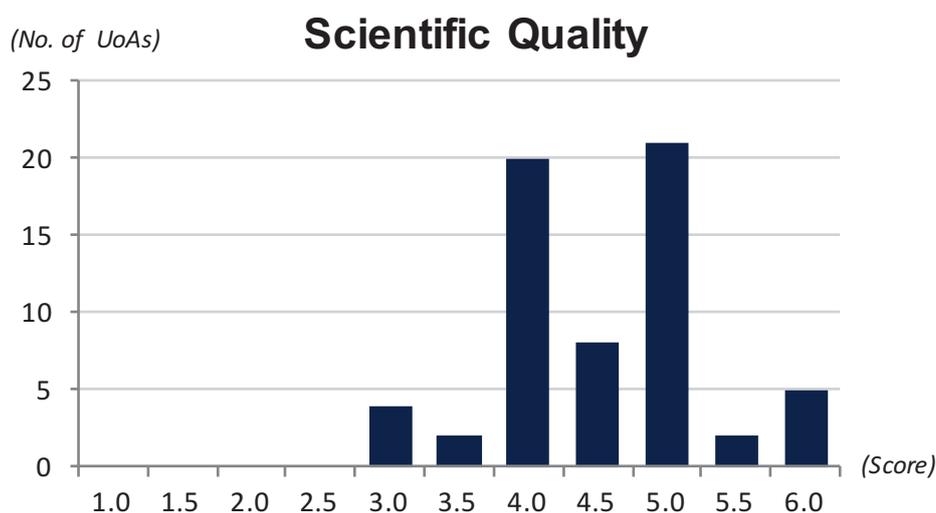


FIG. 3.1.1 Distribution of scores for the criterion “Scientific Quality”. The vertical axis indicates number of UoAs with a specific score. The horizontal axis indicates scores. A score of six corresponds to “world-leading scientific quality” and a score of one corresponds to “poor scientific quality”. See section 2.3.1 for details.

Characteristics of strong UoAs

High scores were awarded to UoAs whose research typically covers both breadth and depth – *“In spite of the broad range of topics covered by this UoA the panel was impressed by the fact that this did not compromise depth”*. UoAs that showed original ideas, engaged in new and emerging issues, and developed and applied advanced/modern methods were awarded high scores. These qualities are mirrored in their bibliometric profiles, with major publications in highly ranked journals. Although very productive in terms of number of publications, the evaluators noted that these UoAs often focused on quality rather than quantity. Several of the UoAs that received top scores for scientific quality worked with both basic and applied research. Invitations as keynote speakers at international research conferences was another characteristic of UoAs with high scores for scientific quality.

Strong research fields

Based on the UoA scoring alone, it is not possible to establish with certainty which of the eleven research fields (i.e. review panels) are the most prominent in terms of Scientific Quality. Since the panels appear to have applied the scoring system somewhat differently, direct comparisons of mean scores may not be relevant. The seven UoAs with top scores (6 or 5.5) are included in the following research fields: “Genetics, Molecular Biology and Physiology” (3 UoAs); “Plant Protection” (2 UoAs), “Aquatic and Terrestrial Ecology” (1 UoA); and “Soil and Environmental Sciences” (1 UoA). However, the panel overviews and the oral reports given by the panels to the SLU Management clarified that areas of excellence are present also in other research fields. Further, it should be noted that some fields had a very broad scope, spanning both basic and applied research.

The bibliometric analyses suggest that in terms of scientific impact, i.e. the top 5% most-cited papers in Web of Science, the following areas were most prominent: “Nature and Society” (17 %), “Genetics, Molecular Biology” (14 %), “Plant Protection” (13 %), “Soil and Environmental Sciences” (12 %) and “Aquatic and Terrestrial Ecology” (12%). The high position of “Nature & Society” is noteworthy since traditionally, the social sciences publish more monographs and books and fewer articles in peer-reviewed journals – evidently this is rapidly changing. In this case, the relatively small number of total publications, accredited to a few very productive researchers, may explain the result.

It can be noted that seven of the 11 review panels awarded no scores below 4.0. However, since the panels have used the scores in different manners, this does not necessarily mean that those research fields have a truly higher overall quality than other fields.

Factors associated with lower scores

Evidently, lower scores (3.0 – 3.5) were given to UoAs that had not made the same achievements as the top UoAs. The reasons for this may be due to varying and specific factors. However, the panels typically pointed out a broad and not very clearly-defined research profile as well as lack of commonly agreed strategies or concepts.

3.1.2 Scientific Environment and Leadership

This criterion covers a broad range of qualities of the UoAs. It includes aspects of the intellectual environment, its impact on the scientific field, collaboration within and outside SLU, as well as the degree of interdisciplinarity in their scientific approach.

General picture

As shown in Fig 3.1.2, the scores for this criterion shows a broader distribution than for Scientific Quality, with 13 UoAs (21 %) scoring below 4.0. However, the general picture must be viewed as satisfactory given that as many as 28 UoAs (46 %) scored “Outstanding” or “Excellent” on Scientific Environment and Leadership.

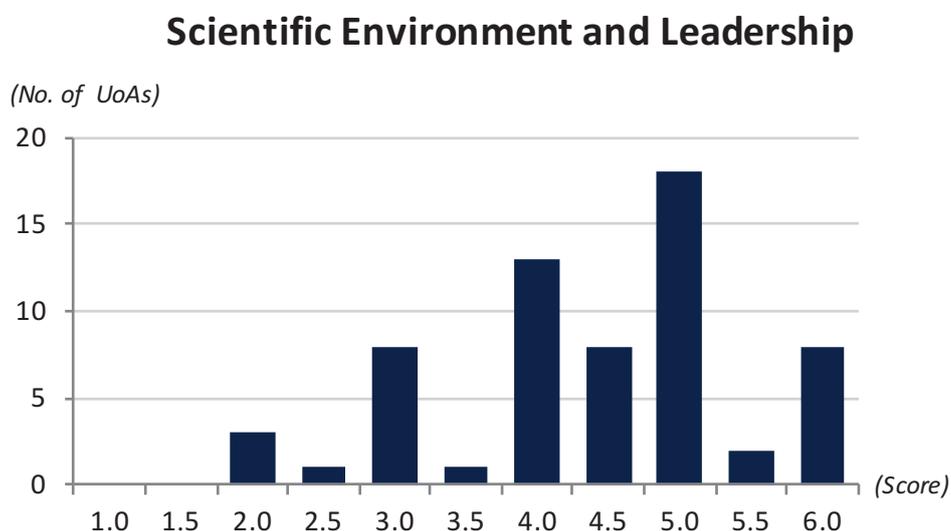


FIG. 3.1.2 Distribution of scores for the criterion “Scientific Environment and Leadership”. The vertical axis indicates number of UoAs with a specific score. The horizontal axis indicates scores. A score of six corresponds to “Outstanding” and a score of one corresponds to “Poor”. See section 2.3.2 for details.

Characteristics of UoAs with strong environment and leadership

An important characteristic of UoAs that were awarded high scores for Scientific Environment and Leadership is illustrated by the statement of one panel: *“The UoA has an excellent leadership from professors and senior scientists, who appear to collaborate very harmonically in a team...”*. In other words, those UoAs that have developed a concrete and participatory strategic approach to research give the staff a good sense of being part of a wider research effort rather than narrowly performing in a limited area. Even some smaller UoAs received high scores for scientific environment, expert reviewers suggested the reason being was that the small-size factor was outbalanced by means such as organizing national and international meetings, inviting guest researchers and speakers. Through strategies like this, they were able to promote networking among young researchers and create a creative intellectual atmosphere.

Factors associated with less strong environment and leadership

A low score was in several cases linked to an unstable leadership situation, e.g. a vacant professorial chair, or impending retirement of the current professor. Lack of cohesion and collaboration between scientists within a UoA was also a factor resulting in lower scores. Other factors contributing to lower scores were small group size, a skewed age balance and difficulties with attracting PhD students.

3.1.3 Strategy for Scientific Development

The evaluators were asked to assess the UoA’s strategy for scientific quality and renewal, including how insightful and realistic this strategy was. Further, the UoA’s plans for future research and its potential for

making significant contributions within these, were evaluated. The panels were also asked to identify the most important challenges for further successful scientific development.

General picture

The distribution of scores for this criterion, as shown in Fig. 3.1.3, was much broader than for the two previous criteria. Although a large proportion (19 UoAs; 31 %) were awarded a score of five or higher (“Excellent” to “Outstanding”), 22 UoAs (36 %) scored below four (“Moderate” to “Inadequate”).

This points to a need for further analysis of the underlying reasons, and of which measures that may be necessary to take.

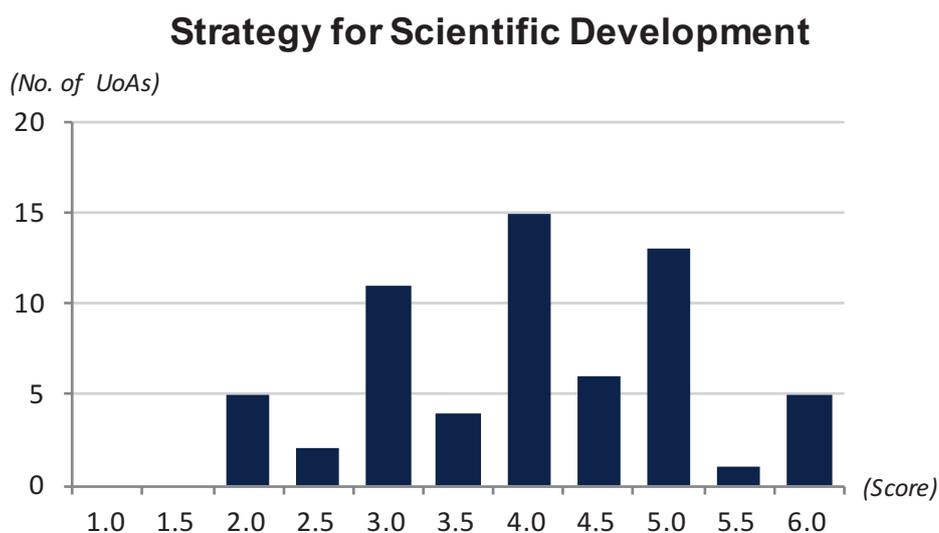


FIG. 3.1.3 Distribution of scores for the criterion “Strategy for Scientific Development”. The vertical axis indicates number of UoAs with a specific score. The horizontal axis indicates scores. A score of six corresponds to “Outstanding” and a score of one corresponds to “Poor”. See section 2.3.3 for details.

Characteristics of UoAs with strong strategies

Units of assessment that could convey a clear direction and a pathway for scientific quality and renewal were generally awarded high scores for “Strategies for Scientific Development”. This, in combination with a demonstrated understanding of the requirements needed for successful implementation of the strategy, were deemed to have a realistic and achievable approach, and they yielded high scores. UoAs that had identified new critical areas of scientific expansion and had outlined a feasible approach to achieve this were also awarded high scores. A comment by a panel succinctly sums up the traits of UoAs with strong strategies: : *“The UoA has thoughtfully developed goals and a strategy to achieve those goals. The strategy gives clear indications of aspirations and a concrete plan to achieve those aspirations.”*

Challenges for further successful development of research quality

The review panels were asked to comment on what they saw as the most important challenges for individual UoAs. In some cases lack of strategic planning or strategic goals were identified as challenges. Frequent comments from the panels related to the need for recruitment of senior researchers and/or junior talent, i.e. postdocs and PhD students. They noted that for some UoAs, succession planning was seen to be crucial. Equally frequent were comments regarding funding (insufficient core funding for salaries, high reliance on external project grants, need for new funding sources). The strong emphasis on

these two sets of factors by virtually all panels indicate challenges that are general for SLU as a whole. However, they may also be caused by the fact that the panels, whose members were mostly international, were unfamiliar with the constraints imposed by Swedish laws for employment in higher education, and the system of governmental resource allocations to universities. More specifically, the comments pointed out a lack of attractive and well-financed career paths for juniors as well as mid-career scientists, the risk of being unable to retain skilled staff, and the need for SLU to speed up recruitment processes, especially concerning replacement of retiring professors.

Other challenges identified by the panels refer more directly to the UoAs' own responsibilities. In some cases, the need for an articulated, common strategy for the UoA was stated as the most important challenge for further successful development. Better coherence, dialogue and integration of groups within the UoAs were pointed out. However, the lack of focus found in some UoAs' research profiles at least in part, may be due to the Swedish funding system, with a high degree of dependence on short-term external grants. In some instances, the need for a clear leadership at the UoA-level was highlighted.

Critical mass was mentioned as a challenge for many UoAs. The panels suggested that this obstacle could be overcome through increased collaboration, with other UoAs at SLU, or with other research actors nationally or internationally. Another challenge mentioned was maintaining important infrastructure, e.g. sophisticated analytical instruments. Access to expertise in bioinformatics was mentioned as a specific, important requirement for some groups. In some cases, a better integration between research and teaching was seen as a major challenge.

3.2 SOCIETAL IMPACT OF RESEARCH

The impact of research in Q&I 2018 is defined as *“an effect on, change in or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia”* (Higher Education Funding Council of England). In this evaluation three principle criteria of the evaluation component Societal Impact of Research were investigated. They included activities and outputs, such as public events where new knowledge was made available, policy papers that addressed an issue of general interest, or new products which that were based on research results were developed. These outputs, if they are well received and actually are used by society, become what are termed as outcomes. Both outputs and outcomes are indicators of how a UoA worked to ensure that their research is suited to help change society for the better. The third criterion upon which societal impact of research was evaluated is the UoAs strategy for research impact.

3.2.1 Activities and Outputs

The general picture

Figure 3.2.1 shows the range of scores for activities and outputs. Seventy two percent of all UoAs achieved the highest score “excellent” and about 26 percent of units achieved the second highest score of “good”. In several reports, the panels noted that high scores for these criteria attested to the UoA's authority in their field of specialization. This increased the visibility and reliability of the research done by the unit and of SLU as a whole. Other comments included that some units achieved remarkable societal impact with regard to outputs due to the synergies between the UoAs' research and its work within the area of Environmental Monitoring and Assessment (EMA).

Activities and Outputs

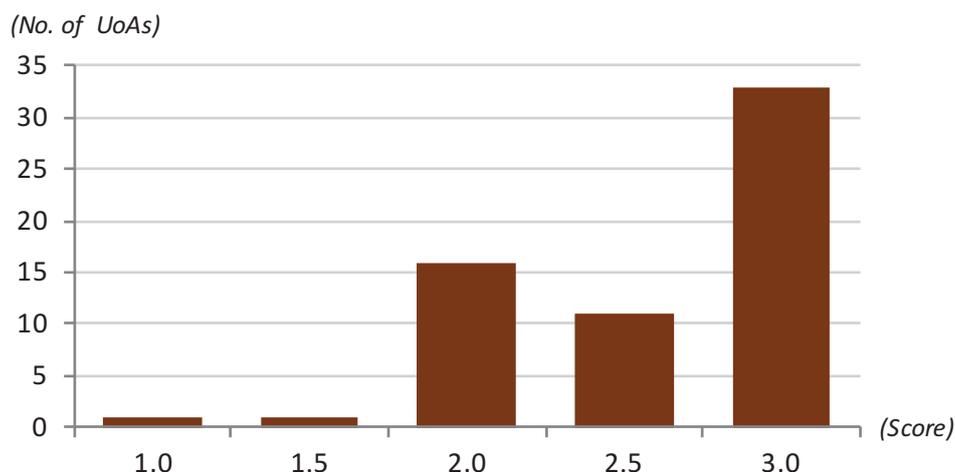


FIG 3.2.1 Scoring of Activities and Outputs of UoAs with regard to societal impact of research. The vertical axis indicates number of UoAs with a specific score. The horizontal axis indicates scores. A score of three corresponds to “Outstanding” and a score of one corresponds to “Inadequate”. See section 2.4.1 for details.

Characteristics of UoAs with high scores for activities and outputs

Comments from the panels for nearly all units highlight successful collaboration with society. Stakeholders most often mentioned are farmers, hunters, extension services, policy makers, consumer organizations, governmental agencies, as well as national and international agencies. Panel reports noted the UoAs’ many collaboration with national and international civil society and non-governmental agencies. A few units identified unusual stakeholders: children, the current SLU student body, and potential SLU students. Panels also noted that “the unique approach of citizen science was a strength in producing relevant activities and outputs; they impact on regional, national and European scales.”

A strength mentioned for units with high scores for activities and outputs was that their long-term monitoring and assessment (EMA) data provided the basis for strong societal impact. Another positive aspect was that units in partnership with low income countries, especially those interactions that resulted in patented products, have the potential for significant international societal impact.

A comment with regard to UoAs and transdisciplinarity described some units as uniquely positioned because they have a social-science orientation in a department dominated by the natural sciences. These units were considered to produce highly innovative findings due to their insights into complex processes that arise between social and economic conditions in the utilization of natural resources. The activities and outputs of another unit were described as being designed to serve a practical need and by filling it, their research results have the potential to achieve immediate societal impact.

Recommendations for reaching higher societal impact through activities and outputs

Some of the general comments from the expert reviews include the fact that a number of UoAs have “good” to “outstanding” national impact but with some directed effort could expand to impact international arenas as well. In one case, the panel gave a mechanistic explanation to increased impact through outputs and noted that the “UoA does not reach its full impact potential at present but since they now have acquired EU funding in a consortium, their impact potential will improve.”

Increased collaboration within SLU was another recommendation. Several UoAs were encouraged to work more closely with other UoAs at SLU in order to lift not only the visibility and thereby the impact potential of SLU but also the work done in their areas of research. In several cases panels commented that the UoAs could make special efforts to communicate high-quality research results so that it was easy for international media to pick it up. Others stated that the applied nature of research makes it a candidate for high potential impact, but their outputs would be utilized more if they focused more on communicating research results.

A unit that clearly impressed the expert reviewers got a recommendation: *“this unit has listened to industry and done research relevant to the sector with clear impact. As a result, they should reflect on how to institutionalize good personal contacts, this so as not to be dependent solely on good individual connections.”* Along the same lines, a recurring comment was that some units have too high of a dependency on one funder and just a few stakeholders.

As mentioned, most units got high scores for their activities and outputs, but received comments such as *“the unit has potential for strong impact but it is on an ad hoc, informal basis – the unit and society would benefit from a more stable platform to make their research results more visible”*. One resounding recommendation was that SLU could have higher impact if it decided to be more of a food university and include more aspects of the entire food value chain to appeal to younger generations. A concrete recommendation related to this was that UoAs could engage in high-school outreach for higher potential of impact within food-related topics.

3.2.2 Outcomes

There was a wide variety of outcomes identified in the expert review panels (i.e., new crop varieties, disease-treatment guidelines, or expert advice for changes in legislation). A recurring general comment was on the long process of research results becoming available and used by stakeholders and society. Yet, over 70% of the UoAs achieved the highest score of “excellent” for their outcomes. Even so, comments about many UoAs revealed that the expert review panels thought that the UoAs could reach even higher potential in terms of outcomes.

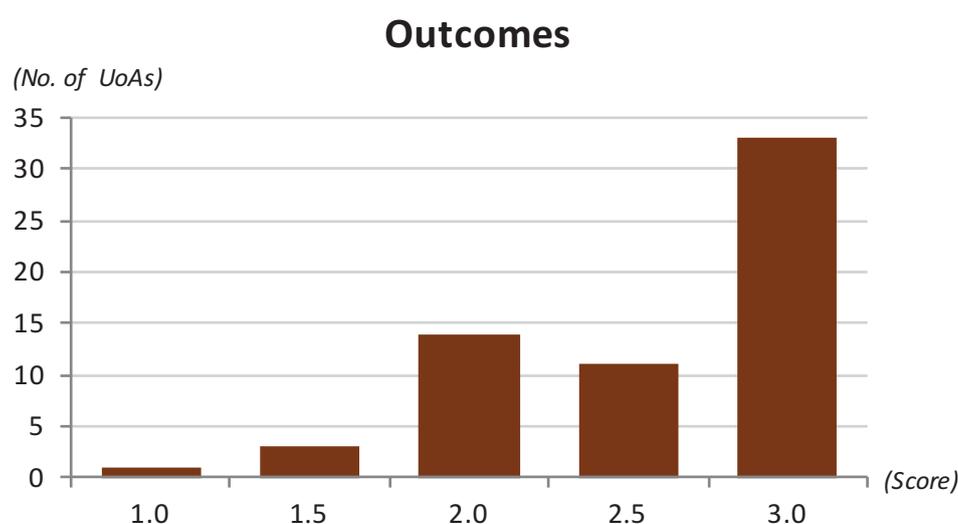


FIG. 3.2.2 Scoring of Outcomes of UoAs with regard to societal impact of research. The vertical axis indicates number of UoAs with a specific score. The horizontal axis indicates scores. A score of three corresponds to “Outstanding” and a score of one corresponds to “Inadequate”. See section 2.4.2 for details.

Characteristics of UoAs with outcomes that have high potential to impact society

Panels remarked that those units with well-developed industry collaboration often had research results and outcomes with high visibility in their sector. They viewed this as an indication of high impact potential on society. Most UoAs got very high scores for their outcomes, yet in almost all cases, panels commented that the UoAs could be even better at making sure that their research results lead to better use by stakeholders.

Several UoAs mentioned that their research results were applicable to the United Nations Agenda 2030 and the Sustainable Development Goals (SDGs) and listed outputs that contributed to long-term solutions to global challenges through for example, the development of biomaterials. Panels encouraged other UoAs when communicating their outputs, to more clearly define with concrete examples how their work was related to the SDGs.

Recommendations for reaching higher societal impact through outcomes

Panels reminded UoAs that research groups with good industry collaborations have an outstanding situation from which to aspire to high international-arena impact. UoAs that work on a regional or local scale were recommended to put effort into reaching outcomes that affect society on national and international scales. With regard to “*SLU becoming a food university*” some panels said that UoAs could be expected to contribute from their own area of research toward impacting society through food. Examples come from a variety of panels, including those that work with new varieties of crops for the Scandinavian market, soil and environment, marketing issues, and especially with consideration to impending climatic changes.

The panels’ reports gave impressions that a challenge in achieving higher impact on society is the UoAs own attitudes toward their research outputs. Expert reviewers remarked that “perhaps researchers were too modest and therefore did not lift their own contributions” or that “*UoAs did not really understand how much influence they might exert on the surrounding society*”.

Other thoughts conveyed were that the researchers perhaps did not really understand the definition of “outputs” and therefore did not report them in their self-assessments or at the interviews. A common remark by many panels was that “*UoAs could learn to articulate their outputs in a more communicative manner*”.

A few UoAs with high scores for their outcomes for societal impact got comments from the panels that their research seemed to be more of a result of industries’ needs rather than based on their own defined research strategy. The panel questioned if “*the unit’s consultancy services to industry would be of benefit for the unit in the long run*”. UoAs were recommended to widen the base of their stakeholder collaborations, and to work with an approach that leads to collaborations that are more equally balanced in terms of outputs for both partners.

3.2.3 Impact Strategy

Twenty one percent of the units were awarded the top score of “excellent” for impact strategy. About half of the units (47%) achieved the score of “good” and a third (33 %) were deemed to have inadequate impact strategies. In general, the panels’ reports indicate that even though the outputs and outcomes of units’ research were high, most did not have clearly formulated strategic goals. As a result, the units’ research results did not reach full potential for societal impact.

A closer analysis of the comments made in the reports indicates that regardless of the numeric score given to a UoA, the panels were convinced that they could become even better at societal impact through strategic planning. The results suggest an untapped potential of SLU research to affect society for the better. This may explain why the curves for impact strategy in Figure 3.2.3 show fewer units with highest scores for impact strategy than those who received the high scores for activities and outputs (Figure 3.2.1) or for outcomes (Figure 3.2.2). However, the greater range of score distribution for impact strategy could also be interpreted that the units do have strategies, perhaps unwritten ones, but did not manage to convey these to their expert review panels. Yet another interpretation is that strategies for impact are not necessarily the best tool for gaining societal impact. This conjecture however is not supported by the database of comments gathered about the need for and benefits of a strategy for societal impact.

Several UoAs received comments that their unit's strategic approach was very broad. Expert reviewers recommended focus and to be smart about collaboration with other SLU units in order to gain greater impact.

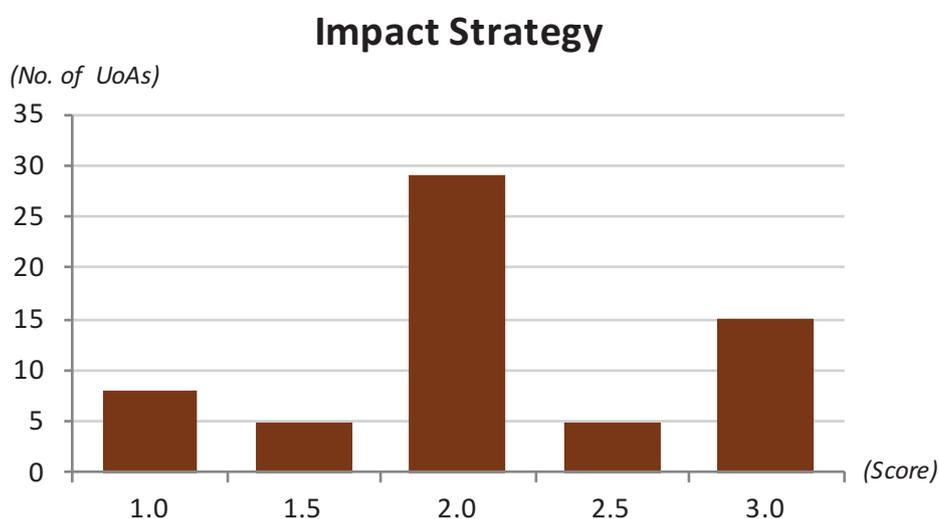


FIG. 3.2.3 Scoring of Impact Strategy of UoAs with regard to societal impact of research. The vertical axis indicates number of UoAs with a specific score. The horizontal axis indicates scores. A score of three corresponds to “Outstanding” and a score of one corresponds to “Inadequate”. See section 2.4.3 for details.

Characteristics of UoAs with strong strategies for impact on society

UoAs that worked participatory research or citizen science approaches into their strategies for impact on society were identified as having high societal impact. Panels noticed that several units from different panels worked strategically to overcome barriers of silo thinking and to contribute to cross-sectoral challenges. For the most part, these units belonged to departments that have invested in hiring external collaboration specialists.

Those units that could convey to their expert review panels that they had both a long-term and a short-term strategy for impact on society were assessed as having an outstanding understanding of the sometimes long process of bringing research results to the use of society. Examples of short-term goals

can be to aim at making new knowledge available to stakeholders and work together with them toward the longer-term goal impacting a process or product in the future.

Recommendations for reaching higher societal impact through impact strategy

Several panel reports described units that had good measurable elements and a strategy for impact but the goals seemed to be too broad and they aimed for significant impact on too many objectives for it to be realistic. Panels thought that some units confused a “strategy for impact” with a “strategy for visibility” and in one case said that the unit’s *“strategies were more like a methods wish list for social media tools”* than a thoughtful approach to increasing impact on society.

Panels discovered some units that had a strategy for maintaining and enhancing their role as an important societal actor but they wondered if it might have been at the expense of scientific quality as measured by highly-cited publications. One unit with very high scores for scientific quality got lower scores for societal impact of research. Panels asked them to remember that the same level of project direction, priorities and resource management is necessary for high impact on society as it is on scientific quality.

Another unit was considered to have achieved almost everything, a clear research vision, distinct core disciplines, research-based teaching and even industrial innovations, but had a distinct lack of focus with regard to their societal impact strategy. On the same note, some units whose research had unusually high impact on the health and well-being of people got the lowest scores for strategy for impact. The panels found it remarkable that while the outcome of the units’ *“research was clearly targeted for use in society, yet they could not articulate a strategy for impact”*. In other cases, the expert reviewers could identify a few units with individual researchers who conducted potentially high societal-impact research but there was almost no connection with the rest of the UoA or even to SLU. Panels regarded this to indicate that there was no strategic thought in pursuing this area of research from a SLU perspective.

Panels considered that some units did not fully understand that their areas of expertise could be valuable for wider networks or that their research results had such high potential for societal impact. Recommendations by the panel to address this was: *‘The unit needs to create a more ambitious strategy and action plan for getting their results integrated into international networks.’*

There were several instances where expert reviewers commented on the fact that the work done in the UoA could be framed within the context of securing an adequate food supply particularly for the Nordic countries. The panel observed that this would be a strategic goal worth developing for the UoAs and for SLU as a whole.

3.3 CAPACITY FOR COLLABORATION WITH SOCIETY

In this evaluation, Quality and Impact 2018, SLU assessed the capacity for collaboration with society for the first time. There are no established systems for assessing collaborative capacity, so this evaluation was in a sense a trial for developing a more robust evaluation system. For that reason, a numeric scoring of collaborative capacity was omitted, but the expert reviewers were instructed to give qualitative assessments and constructive recommendations to the units based on self-assessments and case studies. The review panels had been composed to include expertise in collaborative processes to facilitate this assessment.

The aim of including collaborative capacity in the evaluation was two-fold. First, to increase awareness among the UoAs by encouraging them to reflect on how they collaborate with non-academic stakeholders and describe what potential benefits this has had on scientific quality/development. Second, to get a general overview of how the university, at different levels, could promote and develop the capacity for collaboration with society.

3.3.1 Overall assessment of Capacity for Collaboration with Society

The review panels were asked to give a qualitative assessment for each UoA based on their self-assessments, the collaboration case studies, and what came up during the interviews. In the self-assessments the UoAs were asked to describe their approach to collaboration with society, what the benefits are for research, and what characterizes a successful collaborative process. The collaboration case studies served to give concrete examples of collaborative activities and reflections on the process and results. Further, one of the collaboration case studies was aimed at describing an activity that did not go as planned, to stimulate reflection on “lessons learned”.

Overall, the majority of UoAs were assessed as having well-developed collaborations with society which here refers to all kinds of non-academic actors, e.g. industry, private companies, authorities, policy makers, civil society, other organizations and the public. Furthermore, most UoAs were described as having a good or a well-developed understanding of the collaborative process and the interdependencies that require attention for successful collaboration.

3.3.2 Recommendations for developing capacity for collaboration outside academia

The recommendations covered a breath of approaches and ideas. They ranged from the obvious, such as increasing the amount of collaborations, to more complex proposals about how to prioritize engagements to find a healthy balance between scientific development and collaboration activities. Many recommendations targeted the UoAs’ specific subjects, while others were of a more general character. The latter has been summarized below.

Collaboration strategy

Though many groups were described as having well-functioning collaboration with stakeholders and actors outside academia, several of the panels recommended that the UoAs develop a strategy for their collaboration with society. A rationale for doing this was to avoid collaboration activities and networks that are dependent on specific individuals. Other recommendations included creating a collaboration strategy that included plans for communication and outreach, and to engage professional facilitators for help in developing these strategies.

Collaboration strategies would also serve to support those UoAs that were identified as perhaps having too many ongoing collaborative activities. The panel’s recommendations to these groups was to prioritize their commitments in order to avoid negative effects on their capacity for scientific development. With consideration to the amount of UoAs’ resources in terms of staff time that goes into collaboration, panels noted that an important part of planning is to find a good balance between collaboration and research, without jeopardizing scientific depth.

Building networks

Many recommendations on how the UoAs could further develop their capacity for collaboration related to how they could develop relevant networks. One straightforward suggestion was that UoAs should reflect on and identify their important stakeholders, and to consider which relevant stakeholders are not covered in their present networks. The latter comment was specifically targeted at UoAs that had long-term and well-established collaborations that included only a narrow stakeholder-group, such as specific governmental authorities.

To promote development of external networks, one suggestion was to strengthen internal networks within the university, and thereby an exchange of knowledge and experience. SLU's Futures Platforms were seen as a good starting point for such internal networks. The evaluation panels recommended increased internal cooperation with research groups in similar subject areas, as a means to gather relevant resources and experiences for developing external collaborations.

External networks through which new collaboration could be initiated were suggested. These included interacting with alumni, establishing more programs for industrial PhDs, and creating more adjunct research positions. Establishing advisory groups that include stakeholders was also suggested.

Using networks

Panels stressed the importance of external networks for UoAs to identify knowledge gaps and to formulate relevant research questions. External networks could also help UoAs to improve their understanding of stakeholders' expectations and objectives, and to develop their ability to see the "system-perspective", including the research groups' unique role in the system. The panels also suggested that the external networks should be used as platforms for discussing multidisciplinary approaches to address relevant challenges, and to improve the skills of research groups to take an "outside-in" or target-group perspective.

University-level support

The evaluation panels identified a need for various forms of support from the university to promote collaborative capacity among research groups. One such recommendation was to introduce and strengthen an engagement plan of stakeholder-public-academia with a joint problem-solving atmosphere. A part of this could be to establish "society interface boards"; the Futures Platforms were seen as potentially instrumental in this context.

Several of the evaluation panels highlighted that SLU could strengthen and promote collaboration and collaborative capacity through an incentive system. The following quotes exemplify this recommendation: *"No recommendations needed, but the University should reward the collaborative efforts"*, *"The UoA is already excellent in this area. Our main recommendation is that this is better recognized and rewarded at the University level"*, *"The University must establish a reward system for collaboration with society"*.

Outreach and communication

Outreach and communication, which are primarily unidirectional actions, are to some extent separate from the University's definition of collaboration, with its focus on mutuality. It is nevertheless an important part of the University's mission in society, and may well facilitate future interactions that can lead to more formal collaborations through increased knowledge about SLU and its operations. The review panels have identified this, and many recommendations touch upon this subject.

Outreach and communication are, to some extent, separate from SLU's definition of collaboration with its focus on mutuality. They are nevertheless important parts of the university's mission in society. The review panels recognized that they could facilitate future interactions that lead to formal collaborations through increased knowledge about SLU and its operation. Many recommendations touch upon this subject.

It was recommended that the University should invest in a mechanism whereby researchers could broadcast/disseminate their findings (this was in reference to a Yale program on climate change communication). The underlying idea is that research groups could gather around a common mission to communicate their findings in relation to, for example, sustainability. This goes hand-in-hand with the recommendation to take advantage of an increasing need for science-based information in popular discussion forums as part of an overall communication.

The Review Panels expressed a need for support from the university administration in outreach and communication activities. In particular, the role of the university's division for communication should be strengthened in making the research groups and SLU more visible. The digital presence of several groups could be strengthened in order to promote areas where the public has an expressed interest. Different ways of communicating with society creates awareness and increases interest in the University's key areas of science.

3.4 STRATEGIC WORKSHOP

A strategic workshop was held to take advantage of what the review panels identified as challenges and opportunities for the university on a systemic level. The aim of the workshop was to give the SLU Management an external perspective on things that panel members, as "critical friends", had identified as important for the development of university operations. Several themes and topics were repeatedly highlighted in the group work during the workshop, indicating areas of particular relevance for SLU. Here they have been summarized under headings in an attempt to group similar topics, though they are often relevant in many contexts.

3.4.1 *Strengthening the role of SLU in supporting society - "The golden egg"*

An encouraging and recurring theme was the view of SLU as having scientific excellence within many areas of societal relevance, not the least for the transition from a fossil-based society to a bio-based society. Another was that SLU has well-developed infrastructures and strong connections to industry and other stakeholders. *"You are unique in having access to all of this at the same time" – "This is your golden egg"*. The expert reviewers identified many individual groups and areas that had seized this combination of opportunities, and they encouraged the SLU leadership to capitalize on this opportunity for the university as a whole.

During the plenary discussion, suggestions were raised on specifying the mandate of SLU as a sustainability leader, and to use this as a tool for increased recognition and visibility (branding). The United Nations' Sustainable Development Goals (SDGs) was suggested as a potential framework for developing the university as a sustainability leader, its organization and communication.

The expert reviewers also acknowledged challenges connected to this theme. The need for SLU to strengthen the social sciences was identified as a critical factor to develop a full sustainability portfolio. This is further discussed under the heading "Social Sciences, humanities and interdisciplinarity". Other

related issues related were that some groups did not have a clear vision for their research in relation to societal challenges, while other groups were found to have a disproportionate focus on outreach, negatively affecting the time available for research.

3.4.2 Strategic planning

Most, if not all, panels had concerns regarding strategic planning at SLU. This related to all levels, from individual research groups to university management.

This is reflected in the evaluation results for UoA strategies for scientific development (section 3.1.3), as well as strategies for societal impact (section 3.2.3). While UoA results overall are excellent for scientific quality (section 3.1.1), leadership and environment (section 3.1.2), impact output (section 3.2.1) and outcomes (section 3.2.2), the results for strategies show a significantly higher variability. According to the panels, some groups seemed to lack strategic planning, and had difficulties in answering questions about their aims and goals. Some panel reports highlighted the problem of insecure funding as a contributory factor, leading to scattered research and the favoring of short-term planning for “survival”, at the cost of needed long-term planning. However, the evaluation panels identified groups that had done an excellent job with their strategies and plans; they recommended that these groups be used as models for the entire university.

In addition, the panels identified a lack of knowledge among the UoAs about the content of existing strategies at the department, faculty and university levels. They saw a need to align strategic plans between these organizational levels.

One suggestion to the SLU Management was to establish an international advisory board, as a means to obtain important external input for strategic processes at SLU on a regular basis.

3.4.3 Leadership

Issues related to leadership were raised in many of the panel discussion groups. As in the discussions on strategic planning, these spanned from individual research groups to the level of SLU Management.

The management system at the departmental level seemed to the expert reviewers to be set up very much from the top, with a strong dependence on individual principle investigators. The expert reviewers identified a problem with strong leaders moving up in the university hierarchy, where a pyramid-shaped leadership structure seemed sometimes too strong. Groups that were void of a leading professor, and that consisted of brilliant team members waiting for academic guidance exemplified this. Expert reviewers suggested that young, talented researchers should be given the opportunity to participate in the leadership and dare to take initiatives.

Another leadership-related topic raised by the expert reviewers was their impression that research groups, there had a feeling of always being short of resources; this was seen as a factor leading to an atmosphere of insecurity. Such a mind-set or culture could be avoided through clear, shared visions and goals, which the panels saw as the responsibility of the leadership at all levels.

3.4.4 Recruitment and career pathways

This is ultimately an issue of strategic planning, but concerns specifically how SLU attracts and keeps academic staff. Many of the issues raised by the expert reviewers on this topic related to systemic-level

conditions such as the research funding system that affects all universities in Sweden, the academic career pathway at SLU and how it is used, as well as incentives for mobility and internationalization.

Many expert reviewers reported that they saw a challenge with the insecure funding situations for senior staff, in particular with regard to the high proportion of soft money (external funding) in relation to governmental funding. The expert reviewers also identified this as a challenge in attracting and retaining competence at the university. This relates to the previous topic on leadership, and the notion that it creates an atmosphere of insecurity.

An observation raised in plenum during the strategic workshop was that in general, there were 50–80% female PhD-students in the UoAs, and most times 0% female professors, with steady attrition as one moved up the career ladder. SLU should discuss why this pattern exists: is it that the leadership exhibits unconscious bias in this regard and/or that the funding system inherently favors males over females?

Some of the workshop discussions highlighted succession planning in relation to academic leadership and strategic development. Expert reviewers identified that, senior faculty were soon to retire in some groups without plans for succession that were known to the UoAs. In other groups, professors were already retired, and research groups seemed to be absent of academic leadership. One suggestion to the SLU Management was to invest in structures that allow for better planning for overlaps and continuation to avoid unproductive transition periods.

Another theme that the expert reviewers raised was the opportunity for SLU to promote mobility among the academic staff. These discussions were linked to the development of new competences and were also seen as a means of increasing the university's societal impact. Some had identified that mobility from the outside to the university seemed to work very well, whereas very few senior SLU researchers took the opportunity to temporarily conduct research at other universities. Suggestions on increasing the mobility were to develop adjunct programs, guest researcher programs, and promote sabbaticals.

The expert reviewers also saw a need for greater possibility of promoting faculty to positions as professor. They argued that if these possibilities are too scarce there is a risk that talented faculty will seek career opportunities elsewhere.

3.4.5 Structural conditions at SLU

The expert reviewers had number of observations related to the university organization, and consequences thereof. One such observation was that the panels found it difficult to understand the SLU organizational system, with layers of middle management and some departments being managed by two faculties.

Some groups raised questions regarding the faculty structure, and whether the division into four faculties was optimal for university management. Discussions concerned how this organizational solution potentially complicated recruitment, productivity and growth. Further, the faculty structure was perceived as an example of a barrier for internal collaboration. In some cases this was seen as a reason for overlap in certain subject areas.

Other types of barriers to be avoided were discussed by the expert reviewers. The geographical barrier between faculties and departments was mentioned, more as an observation than a prioritized challenge.

Another kind of barrier was related to the interactions between research and education. Expert reviewers identified an imbalance in assignments where some UoAs were heavily involved in education, while others had no, or very limited teaching duties. They expressed that excellent researchers should be more involved in teaching and thereby contribute toward the integration of education in strong research environments.

A structural or organizational effect perceived by panels was a dichotomy between the basic and applied sciences. The assessment of many groups was that they focused either on basic or on applied sciences. However, some groups were identified as doing excellent basic research, applying that knowledge to real problems and contribute to societal development. According to the expert reviewers, all groups need not excel in both areas, but SLU should take responsibility for providing a structure that ensures a process where these competences are combined.

3.4.6 Incentives

A number of incentives, as a means to address opportunities and challenges, were brought up during the workshop discussions.

Some low hanging fruits that could be easily harvested were identified by the expert reviewers in their meetings with research groups. A reluctance to compete for EU-funding (e.g. Horizon-2020 and ERC) was, to some extent, explained by the problem that indirect costs are not fully covered, resulting in a need to find other financial resources to bridge the gap. Expert reviewers suggested the university could establish common principles for co-funding of indirect costs, and could allocate resources for this. Similar ideas were raised concerning funding of PhD-students. Many research groups voiced the challenge of securing funding for the fourth year of PhD-education, given that most governmental funding grants are limited to three years. Common principles at the University level, in terms of incentives and funding for recruiting PhD-students were seen as likely to overcome this barrier.

A number of research groups seemed to be unaware of their potential to attain international recognition, given their skills and capacity. Other groups were perceived as being content with their situation, operating in a “comfort zone”, and did not exploring what the external reviewers viewed as their full potential. Expert reviewers reasoned that groups like these should be encouraged by the university and argued that incentives do not necessarily have to be in the form of resources, but that it is equally important to give the groups recognition for their work. As one expert said, *“researchers are not in science for the money, they are in it for the fame”*.

Related to the discussions on the role of SLU as a sustainability leader and on the university’s opportunity for societal impact, the expert reviewers suggested establishing an incentive system for collaboration. They reasoned that the university as a whole needs not only to be excellent in science, but also to focus on support structures to transform scientifically-based knowledge into societal impact. One important incentive in realizing this transformation, as argued by the expert reviewers, is to value collaboration. Academic staff members that work on outreach and collaboration with society need to be recognized for this, and a system that considers this to be a qualification for career-development should be established.

3.4.7 *Social Sciences, humanities and interdisciplinarity*

The role of social sciences and humanities were discussed extensively, despite the smaller size of these subject areas in relation to the dominating natural sciences at SLU. Expert reviewers stressed the importance of social sciences and humanities for the university's mission in sustainability. A point was raised that sustainability is a human construct, and that the university therefore needs to have strong social sciences to accomplish the sustainability mission. They observed that some groups in the social sciences felt marginalized, and were asked often by colleagues in the natural sciences to become involved in interdisciplinary projects at a late stage, instead of being part of project development from the beginning. The University Academic Management were advised that faculty in the social sciences and humanities must not be embedded in the natural sciences, but rather are to be encouraged and supported so that they may achieve critical mass on their own.

The Futures Platforms, and other arenas for discussing and implementing specific topics, were raised as good initiatives for promoting interdisciplinary projects. Expert reviewers, however, pointed out that these cross-faculty structures seemed not to be utilized to a great extent by research groups. The review panels considered these strategic initiatives to be an outstanding but unexploited opportunity that could be realized through better internal communication. They also saw a need for a more bottom-up process to make sure that these platforms become functional in terms of collaboration and communication, and that they involve people across faculties.

4. DISCUSSION

4.1 RELATION BETWEEN EVALUATION CRITERIA

One interesting question to analyze was the co-variation of scores between the various criteria for quality of research and societal impact. A correlation analysis does not give causal explanations, but could still give an idea of how the different criteria are inter-connected. The analysis was performed using a non-parametric statistical test (Spearman's Rank Order Correlation), given the ordinal nature of the scoring. The results of the tests were then adjusted for multiple comparisons using the Bonferroni procedure.

The results of the analysis are summarized in Figure 4.1. The six nodes, each representing one of the evaluation criterion, have been inter-connected by a ribbon in those cases where the test showed a significant correlation between any two criteria. The width of the ribbon indicates the strength of the correlation.

The most evident result is the positive correlation between the criteria "Scientific Environment and Leadership" and "Strategy for Scientific Development". Although the analysis does not support any inference on causality, it is not difficult to picture a logic where these two criteria go hand in hand. Groups that were awarded high scores for "Scientific Environment and Leadership", meaning that they, among other things, maintained a creative, and intellectually vigorous and productive environment, were more likely to also have obtained high scores on "Strategy for Scientific Development". In a sense, these two criteria overlap to some extent, which might explain the high co-variation in scoring. Further, these results were also correlated with high scores for scientific quality, which seems well in line with having both a beneficial scientific environment and strategies for scientific development.

Another clear result is the correlation between the criteria "Strategy for Scientific Development" and "Impact Strategy". It might not be far-fetched to think that the likelihood of a UoA having a good impact strategy is higher if they also have a good strategy for scientific development. There is also positive relation to the criterion "Scientific Environment and Leadership". One possible conclusion is that these three criteria represent part of a beneficial "academic culture", with good leadership, a creative environment, and guidance in terms of clear strategies. This would also explain the links to the good results in terms of scientific quality, activities and outputs, and outcomes.

The non-existent relation between "Scientific Quality" vis-a-vis "Activities and Outputs", and "Outcomes" in the illustration above might be seen as an unforeseen result. A likely reason for the absence of this correlation is the fact that the distribution of scores for the two criteria "Activities and Outputs" and "Outcomes" have very little variation. The majority of UoAs have top scores for these criteria, which is of course very positive, but this positive lack of variation also makes it impossible to quantitatively identify a potential relation between these criteria.

Those six UoAs that got the absolute best scores for the "Quality of Research" (18 or 17 of a maximum of 18), also received the highest scores (nine or eight of a maximum of nine) for the criterion "Societal Impact". For these units there is no trade-off between attaining outstanding scientific quality as well as achieving the highest societal impact of their research.

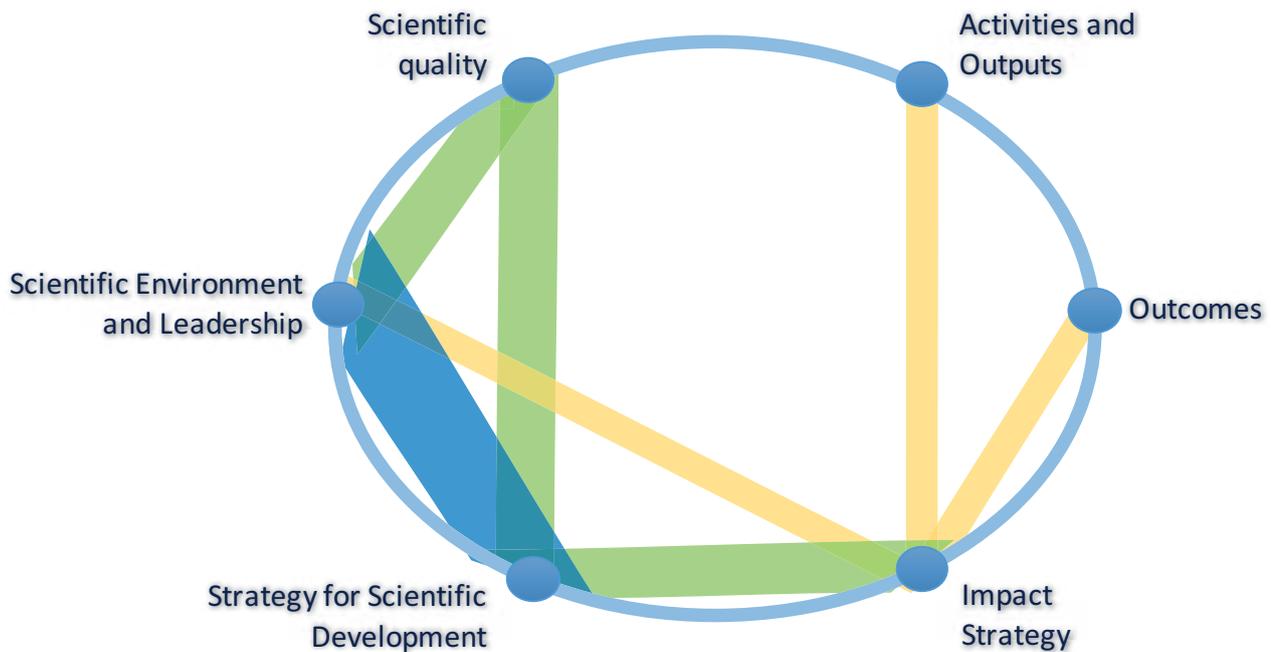


FIG 4.1. Correlations between criteria for quality of research and societal impact of research, where each node corresponds to one of the criterion. The width of the ribbons indicates the strength of the correlation (blue: $\rho > 0.8$, green: $\rho = 0.5-0.8$, yellow: $\rho < 0.5$).

One panel brought to light a time factor to consider in the relationship between outputs and outcomes. Within a relatively short time frame, research results can be made known to society through various activities and outputs but, it takes much more time for stakeholders and society in general to use the results. *“It can take ten to fifteen years to launch products, for example in the forestry sector.”* This panel thought that in reality the outcomes that were described by the UoAs could have a stronger correlation to activities and outputs from ten years ago or more.

4.2 QUALITY OF RESEARCH

4.2.1 Potential for developing the quality of research

Although the review panels highlighted a number of strong research areas there was room for improvement on many points. Whereas the results regarding the criteria “Scientific Quality” and “Environment and Leadership” were satisfactory, the evaluation panels were considerably more critical when it comes to the ‘Strategies for Scientific Quality and Renewal’ presented by the UoAs. Either this result indicates that many UoAs do not see the need for strategic planning, or, that they do not have the leadership skills and knowledge necessary for carrying out an adequate strategic process. However, other factors may also be of importance. As one panel put it: *“Reliance on external funding weakens the ability to pursue a coherent strategy in scientific topics and leads to a broad range of subjects and goals.”* Thus, further analysis is needed and careful consideration of which measures SLU should take to motivate and support the UoAs in this task.

Two panels also commented that the high degree of reliance on external funding seems to make researchers prone to conduct established, mainstream research, and avoid risky research which has the possibility lead to unique, world leading research directions. They suggested that SLU should consider measures to encourage high risk/ high gain research.

International collaboration

The general picture is that most UoAs at SLU have a good to excellent level of exchange with the international scientific community in terms of e.g. networking, collaborative projects, joint publications, or presence on international committees. Only in a few cases did the panels identify increased international cooperation as an important challenge for further scientific development. In some cases, international collaboration was found to be focused on the Nordic countries or the EU, which experts said was most likely a strategic choice. Many UoAs are quite active in capacity building programs with low income countries, mainly on the African and Asian continents. Some UoAs were commended for their influence at the international policy level. However, while many UoAs showed a very good influx of guest researchers, it is notable that visits by SLU researchers to colleagues abroad occur at very low frequency, which is somewhat unexpected given the generally broad international networks.

Scientific publishing

The issue of publishing strategies was emphasized by all review panels. A number of UoAs were strongly recommended to aim for increased publishing in high profile journals in order to enhance their scientific impact and international recognition. Indeed, one panel stated that *“Most units showed a lack of ambition to publish in high impact journals resulting in a lower visibility.”* In some cases the panels specifically pointed out the importance for applied research to be published in peer-reviewed publications. The recurrence of recommendations to raise the ambitions for scientific publishing is remarkable considering SLU’s good position in international citation analyses, but suggests the potential to raise this position even higher.

Subject overlaps and internal collaboration

Overlaps and a lack of synergy between UoAs were identified by the panels in the areas of crop production, ecology, economics, and plant pathology. They also saw a potential risk of overlap in the field of animal nutrition. Panels suggested that the units could benefit from collaborating more and recommended stronger coordination between the faculties involved in order to avoid dispersion of human resources with similar competences. The review panel “Economics, Business and Management and Statistics” found areas of obvious complementarity across departments and campuses that should be exploited further. They raised the question of whether artificial barriers for collaboration were due to the fact that departments belong to different faculties.

Whereas many UoAs were judged to have excellent collaboration with other UoAs at SLU, some seem not to have utilized this possibility. The panels commented that active participation in SLU’s Future platforms often seemed to be lacking. They saw a great, but unexplored, potential for collaboration within the Future platforms and other joint SLU-structures, and recommended that SLU develop and use the platforms as vehicles for increased collaboration between UoAs. Thus, the SLU leadership could work more purposely on connecting excellent researchers to the activities of the platforms. Specifically, the Future Food platform could be used to clarify the overall SLU strategy for future research and societal impact within food-related science.

Multidisciplinarity

The panel “Nature and Society” recognized SLU’s strategic goal to promote multidisciplinarity and interdisciplinarity, but stated *“SLU is still very much on a learning curve... Strategic actions within SLU are needed to ensure that UoAs with a social science profile have sufficient resources in order to contribute to interdisciplinary work. Only then can the really interesting interdisciplinary questions be formulated.”* They recommend that SLU examine the processes by which the social science UoAs are incorporated into

the scientific and outreach programs in the agricultural, biological, forestry and veterinary sciences. This is necessary to avoid situations where social sciences and humanities become “add-ons” during project planning in order to formally meet demands for multidisciplinary.

Infrastructure

In general, the expert reviewers were impressed with the infrastructure provided by the university, but nonetheless expressed concern about the need for continued funding. Several panels pointed out the need for strengthening of bioinformatics-related methods (e.g. statistics, molecular technologies, machine-learning). Many of SLU's research fields are dependent on investments in high quality bioinformatics support in order to keep up with the rapid technological development. To enable this, they suggested that SLU provide stable funding for relevant staff. One panel suggested that SLU could consider establishing a 'big data' core facility, linked to the already established bioinformatics platform.

Balancing research with other tasks

Several panels commented on the fact that many UoA are facing the problem of balancing research and teaching duties. While some units have a heavy teaching load that (in some cases) may negatively affect research activities and publishing, others have difficulties providing young staff the teaching experience needed for their career development. The panels stressed the mutual advantages of integrating research and teaching, which was noted to be a strength for those UoAs that combined the two. They recommended that SLU should consider new options to achieve balance in teaching, both across different scientific areas, and on “the interpersonal level”. They stated that SLU may also need to work with the negative attitudes among some researchers towards teaching.

In contrast to the Q&I 2009 evaluation, Environmental Monitoring and Assessment (EMA) in Q&I 2018 was not included as a specific subject for assessment. A detailed analysis of the Q&I 2018 scoring

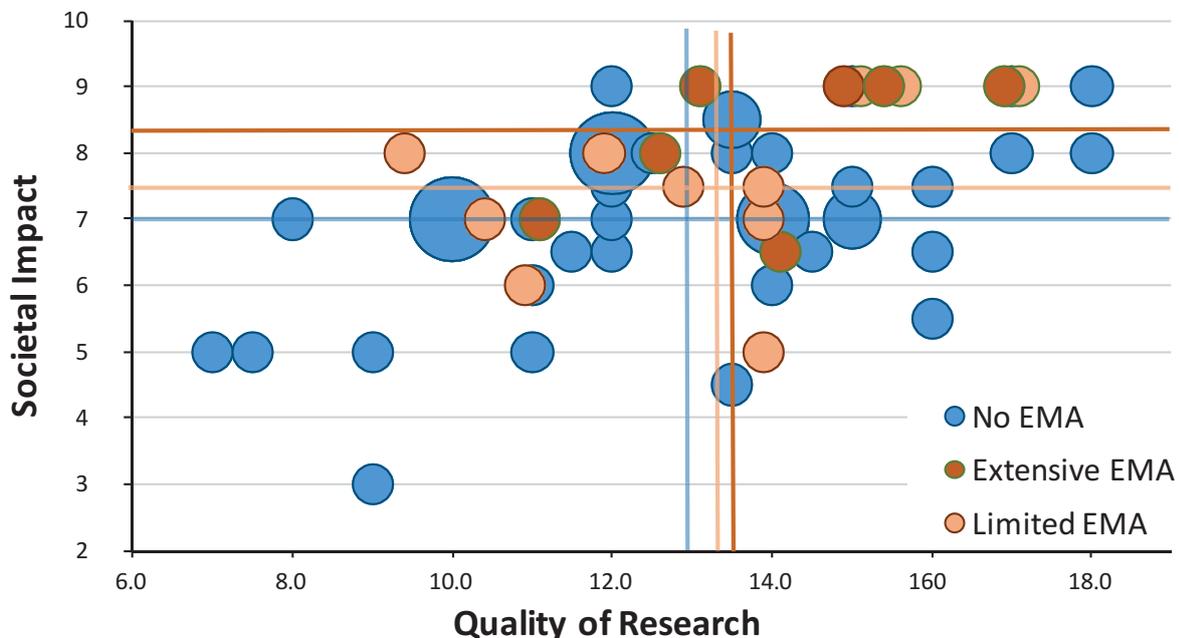


FIG. 4.2. Graph showing the sum of scores for Societal Impact against sum of scores for Quality of Research. Size of circles indicate number of UoAs with identical scores (largest circle = 4 UoAs, smallest circle = 1 UoA). Blue circles - UoAs without EMA, dark orange circles - UoAs with extensive EMA, light orange circles - UoAs with limited EMA. The horizontal and vertical lines indicate mean scores for the respective subgroups.

shows, as expected, that units with EMA activities were very successful in the criteria regarding societal impact (Fig. 4.2). Interestingly, it also reveals that many units with strong commitment to EMA were also awarded high scores for scientific quality. This indicates that EMA activities are not an obstacle for high scientific prominence, and that EMA in itself may actually contribute to such prominence.

4.2.2 Comparison of the 2009 and the 2018 evaluations

The two evaluations performed at SLU, in 2009 and 2018, differ methodologically in several ways, making it precarious to make a full comparison between the two. However, the criterion “Scientific quality” was defined in the same way in both evaluations and the results could therefore be compared directly. The graph in Figure 4.2.1 shows the proportion of UoAs that have obtained scores from one through six for scientific quality. Based on these results it is evident that the scores awarded in the Q&I 2009 evaluation have a wider distribution than in Q&I 2018. A positive result is that a larger proportion of the UoAs were awarded a higher score in the Q&I 2018 evaluation, indicating an overall increase in scientific quality.

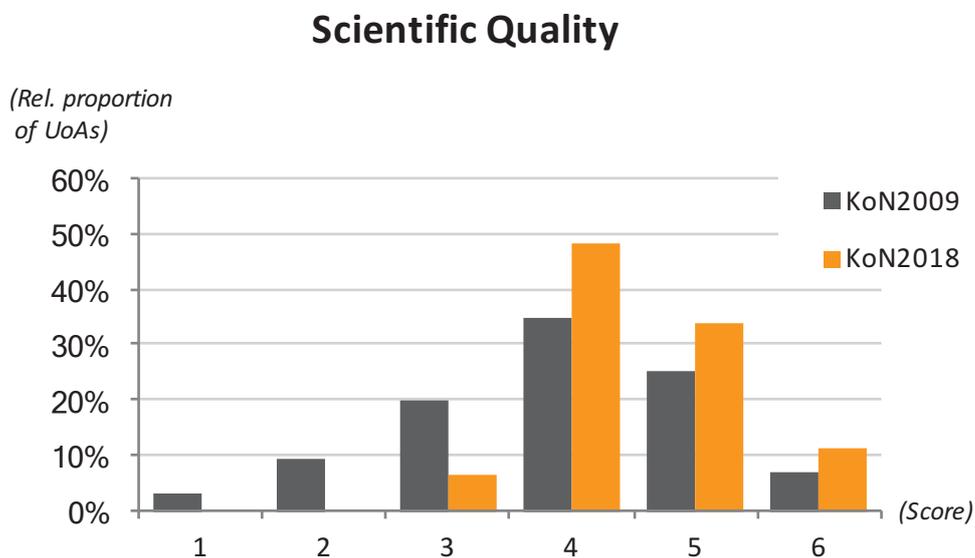


FIG. 4.2.1. Comparison of scores for scientific quality in the Quality and Impact 2009 and 2018 evaluations. The vertical axis shows the relative proportion of UoAs with a given score. The horizontal axis shows the scores.

4.2.3 Does the size of the UoA affect the results?

An observation from the Q&I 2009 evaluation was that smaller UoAs had lower overall scores than the larger UoAs. For that reason, in Q&I 2018 departments were advised not to form UoAs based on specific smaller research topics, but rather base the formation of UoAs on strong functional groups. In Q&I 2009 there were 130 individual UoAs, whereas in Q&I 2018 there were 61 individual UoAs despite approximately the same amount of research staff in each evaluation. This showed that UoAs in the Q&I 2018 were formed to a greater extent by aggregating smaller research groups. From the panel reports, it is clear that some UoAs did not see themselves as a true functional group, but rather as something put together only for the evaluation. To test the idea that results might be affected by the size of the UoA, comparisons (Figures 4.2.2a, 2b and 2c) show how the three criteria for “Quality of Research” relate to the size of UoAs, and if the UoAs constituted a whole department or if they were part of a department.

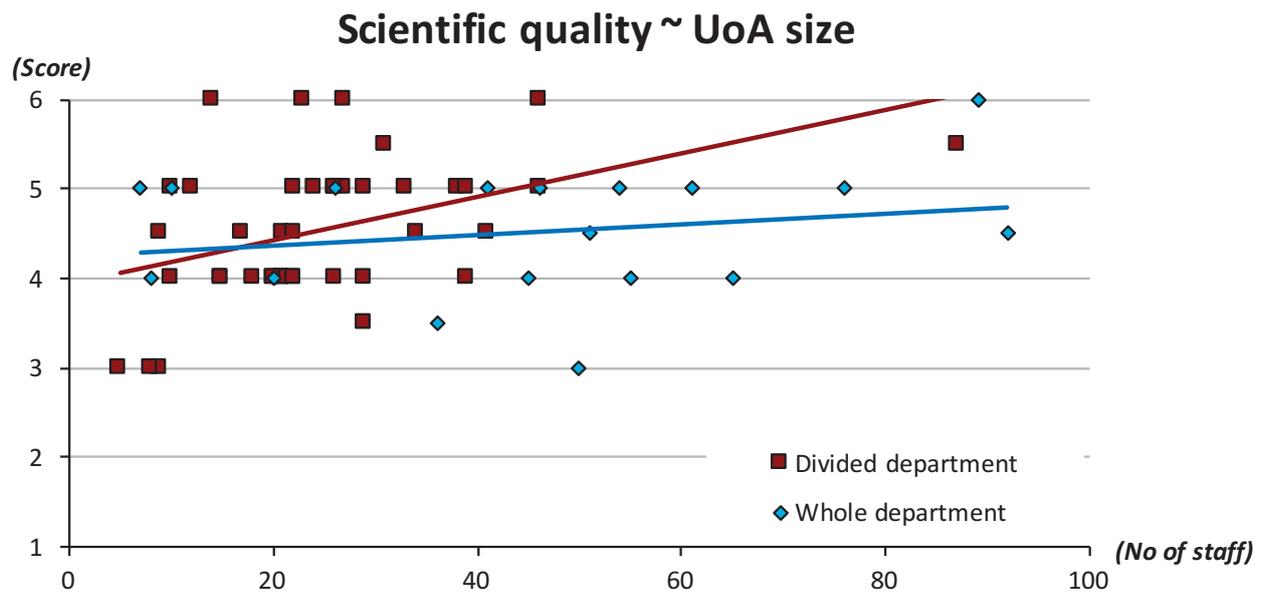


FIG. 4.2.3a. Scatter plot of scores for Scientific Quality against number of scientific staff in the UoAs. UoAs that included an entire department are symbolized by a diamond, UoAs that were a part of a department by squares. Lines indicate correlation trends for each subgroup.

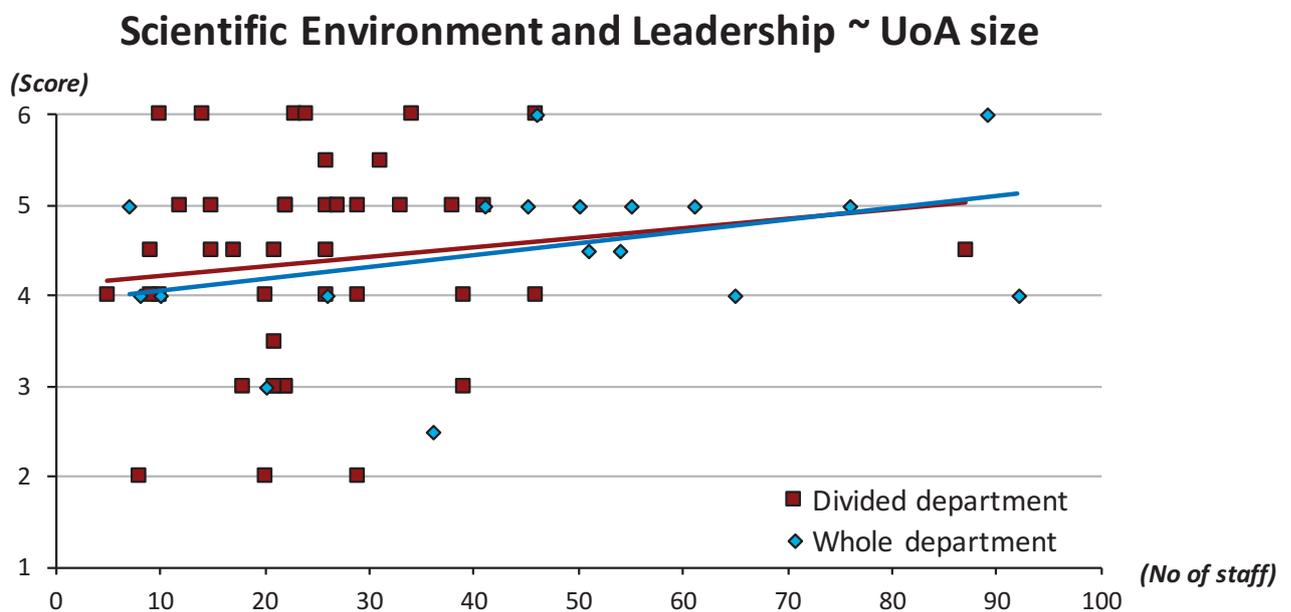


FIG. 4.2.3b. Scatter plot of scores for Scientific Environment and Leadership against number of scientific staff in the UoAs. UoAs that included an entire department are symbolized by a diamond, UoAs that were a part of a department by squares. Lines indicate correlation trends for each subgroup.

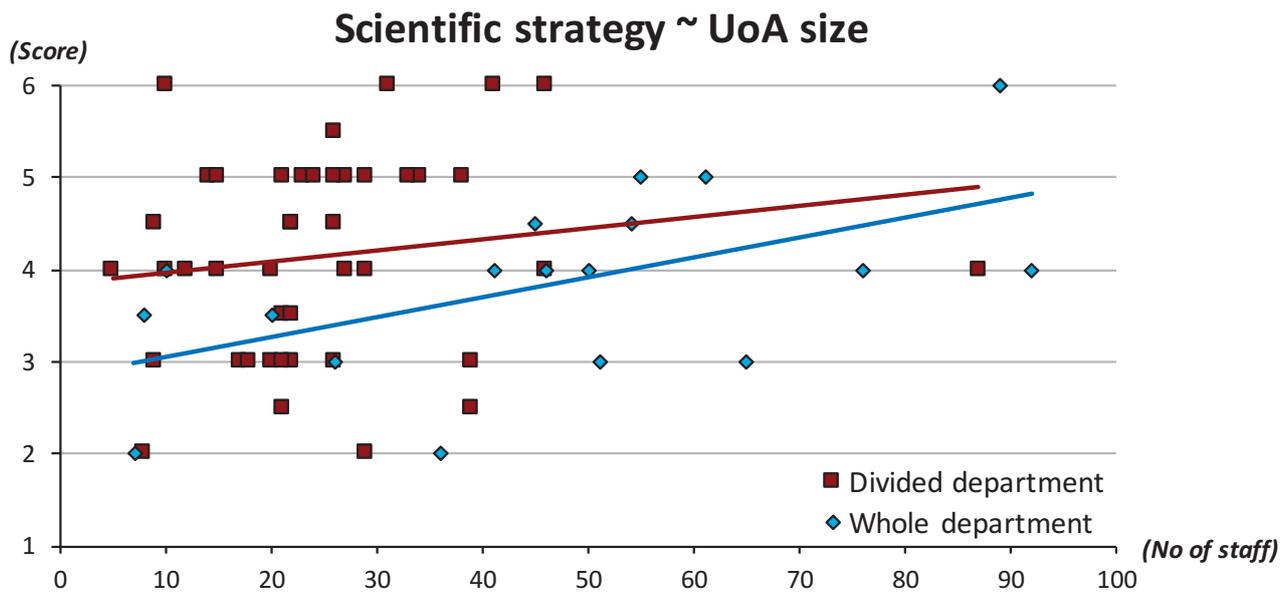


FIG. 4.2.3c Scatter plot of scores for Scientific Strategy against number of scientific staff in the UoAs. UoAs that included an entire department are symbolized by a diamond, UoAs that were a part of a department by squares. Lines indicate correlation trends for each subgroup.

Based on these analyses, there was no indication that the scoring of the criterion for “Quality of Research” was dependent on whether UoAs were part of a department or constituted a whole department. There was a significant positive correlation between number of scientific staff and scores for “Scientific Quality”, but only in the subgroup of UoAs from departments that were divided into two or more UoAs (see Figure 4.2.2a). Additionally, a significant positive correlation existed between number of scientific staff and scores for “Scientific Strategy”, but only among UoAs that constituted a whole department (see Figure 4.2.2c). Given the large variation in the samples for these analyses, the effects of UoA size, although statistically significant, must be considered to have only nominal explanatory value for the results, in terms of scores.

4.3 SOCIETAL IMPACT OF RESEARCH

The expert reviewers conveyed important messages to the UoAs about the societal impact of their research. Although the impact scores were generally high, nearly all panel reports included a statement mentioning that UoAs could be even better at bringing their results into use in society. Many UoAs were encouraged to realize just how important their research results were and to invest efforts to translate their results into a language that was geared to communicate with their most relevant stakeholders. At the strategic workshop expert reviewers told the SLU management that SLU must “*focus on their role in helping society get the future that they want*” and that SLU needs to “*put your results on export to a much higher extent*”.

Expert reviewers expressed that SLU’s greatest resources lie in the importance of food, energy, bio-based economy, animal welfare and the natural and urban environments; the core sciences of the university. Further, the panels gave high scores to most research groups for their efforts in bringing research results to the attention of stakeholders in society. They did, however, also say that SLU’s role of providing evidence-based decision support to society must be made more visible.

4.3.1 Comparison of the 2009 and the 2018 evaluations

In the Q&I 2009 evaluation, SLU was criticized by stakeholders for not doing enough applied research and for not translating research results into useful information that could be used by stakeholders. In the Q&I 2018 evaluation, most research groups received high scores for the societal value of their activities and outputs as well for the outcomes of their research results. Yet panel reports often revealed comments suggesting that the UoAs and thereby the university's full potential for societal impact was not reached. Discussions from the workshop revealed that SLU must continually strive to better disseminate research results, either by finding mechanisms to do so itself or by employing external partners that could. An often-stated comment in the panel reports was that the communications systems in place at SLU are not reaching the stakeholders.

There were several differences in the assessment of societal impact between the two research evaluations. In Q&I 2009 the impact on society of SLU's research as a whole was assessed. The Q&I 2018 evaluation focused on the societal impact of the research conducted by individual research groups. An aim of the societal impact assessment in the 2018 evaluation was to get a better understanding of which mechanisms used by those persons conducting the research work best. Another, difference was that the Q&I 2018 evaluation was designed so that review panels consisted of persons with different areas of expertise and experience. On every panel there were some members with research quality expertise, some persons with expertise in societal impact of research and some with deep understanding of the capacity for research collaboration with society. In contrast, the Q&I 2009 evaluation was designed to have two sections, each with its own separate evaluation panel. One section was dedicated to the quality of research for UoAs and the other dealt with the societal impact of SLU's research as a whole. Thus, the Q&I 2018 evaluation gave a more specific, detailed feedback, but from a somewhat different perspective.

Another difference between the two evaluations related to SLU's mandate area of Environmental Assessment and Monitoring (EMA). A conclusion from the Q&I 2009 evaluation was that SLU's extensive activity within EMA, the datasets compiled, and the resulting analyses should be better integrated into the research conducted at the departments and within individual research groups. In the Q&I 2009 evaluation EMA was assessed separately from the scientific quality part of the evaluation. In Q&I 2018, EMA was not assessed separately, but was instead an integral part of the quality of research and the societal impact of research. Many of the panel reports highlighted the benefits of EMA and research integration.

4.3.2 Reaching full potential for impact of research on society

Incentives

A recurring comment about many of the UoAs that received high scores for societal impact was that while they displayed a good understanding of the stakeholders' expectations, and made research results available to them, the UoAs still did not reach their full potential. Several panels recommended that SLU create incentives for researchers to work with increasing the societal impact of their research by incorporating a merit system for this. The aim is to allow persons who are skilled in conducting high quality research and in facilitating the societal impact of research, to work in both areas without forfeiting their chances for higher academic positions. A recommendation in another direction was to invest more resources for staff that were not on an academic career track to communicate research results to stakeholders. Many of the recommendations for improving incentives for researchers to work with the societal impact of their research were quite similar to those made for creating incentives for the collaborative capacity of researchers with non-academic stakeholders (see section 4.4).

SLU and digital science

The reviewers were enthusiastic about the potential societal impact of the vast amounts of data produced within, for example, the EMA programs, bioinformatics, animal and plant breeding sciences, and the long-term crop field trials. They suggested that investments in digitalization and accessibility of SLU's long-term databases would increase SLU's potential for societal impact nationally and internationally. This would also help profile SLU as a sustainable life university.

Synergies or conflicts in working with quality and impact

A red thread through all the results of Q&I 2018 was that SLU must continue to produce high quality research and at the same time make even more of an effort to ensure that the results come to use in society. The panel reports did not say, however, that both must necessarily be conducted by the same persons or even in the same UoA. Instead, recommendations were to create better infrastructures so that the different capacities within the research groups, departments and in the university could be used effectively to enable quality research results to ultimately affect society for the better.

As mentioned earlier, the six UoAs that got top scores for quality of research also got top scores for impact of research on society. There were however, some cases where UoAs expressed that they were faced with a trade-off in focus between scientific quality and societal impact, they did not have resources to accomplish both. A number of UoAs expressed in their self-assessments or at interviews that their strategic focus was not for impact but for high scientific quality. One unit specifically stated that their strategy was for survival and that meant focus on scientific quality.

An aspect regarding both the scientific quality of research and high societal impact was that if SLU really aims at attaining high societal impact, then the university must integrate the social and the natural sciences. Several panel reports emphasized that interdisciplinary projects, where social and natural scientists are equal partners from the very beginning of research initiatives, will have higher potential for societal impact (see also Section 4.2).

Communicating science with society

Several panel reports mentioned that SLU needs a “*strong university voice, one in which research groups can add on their own research results*”. The strength in a SLU voice could help break through the media background noise. It was also proposed that SLU should focus efforts on communicating the university's research results in the framework of the Swedish National Food Strategy (in Swedish, Livsmedelsstrategin); this would make SLU more visible.

4.4 CAPACITY FOR COLLABORATION WITH SOCIETY

The evaluation panels were asked to give a qualitative assessment on the UoA's capacity for collaboration, in terms of the UoAs' understanding of the collaborative process and the factors affecting it. However, there is no standard for or definition of the collaborative process. The panels were given a short explanation of the concept of capacity for collaboration with society and an introduction to why this was included in the evaluation. In an effort not to influence the panels' views, they were purposely not given specific instructions on what to look for in their assessments.

From the review panels' comments on the UoAs' capacity for collaboration it is apparent that the historical legacy of interacting with the traditional “sectors” is still very much an important part of the culture at SLU. It is also evident that most UoAs have vigorous collaborations with relevant stakeholders and work jointly on topics that are directly relevant for society.

There is a wide span of types of collaborative efforts among the UoAs. At one end of the spectrum there is collaboration that is based on working with specific stakeholders that are close to the subject area, and where the pathways to application and impact of results is short and easily defined. At the other end, collaboration is an integrated part of the research method, and is an essential tool for gathering the necessary data (more common in the social sciences), or is even a research subject in itself.

Based upon recommendations of the Q&I 2009 evaluation, SLU established a new faculty position called External Collaboration Experts. These persons have strong research CVs (are formally Senior Lecturers) and at the same time have proven competence and experience in collaborating with a variety of societal stakeholder. They are persons who serve as experts in their own right, but also serve as a gateway to the vast range of expertise at SLU. In the written assessments, the panels acknowledge the presence of only eight of the twenty External Collaboration Specialists; it is a bit surprising that they are not mentioned more often in the panel reports. An analysis of this fact could be a future follow-up topic.

The expert reviewers' recommendations cover a breath of approaches and ideas. However, few recommendations related to how the UoAs can develop their process capabilities, which indicates that the instructions could have been better formulated, with a more clearly-expressed objective. Many times the recommendations in the panel reports were linked to how the UoAs could promote better societal impact, rather promoting improved collaborative capacity as a means of achieving societal impact.

4.5 WHAT CHARACTERIZES A SUCCESSFUL COLLABORATION PROCESS?

In an attempt to describe the collaborative process and its benefits for scientific quality in relation to the challenges posed by collaborations with external actors, this section synthesizes what the UoAs have described in their self-assessments and in their collaboration case studies, as well as what the expert reviewers have acknowledged and reflected on in their assessments.

Based on the information from the UoAs and the expert reviewers' comments, a set of recurrent key factors or dimensions were identified as important for a successful collaborative process. Here two main categories relating to the mutual nature of collaboration are identified, and the need for developing a relation between partners in the collaboration. They are:

Fostering the relation between partners

- **The importance of dialogue** – all collaborations are based on relations between individuals, and for this relation to work and develop, a continuous dialogue is essential.
- **Developing a common language/understanding** – Constellations of individuals from a specific sector tend to develop a shared understanding and language based on the context in which they act. When individuals from different sectors meet and discuss, they initially do not share this common ground, and need to develop it for a better understanding of each other's contexts.
- **Building mutual trust** – In order to be willing to invest resources in a joint process, it is important to establish a mutual trust to which all partners are equally committed.
- **Open-mindedness / inclusive attitude among partners** – Challenging your own and partners' perspectives are important parts of the collaborative process. A willingness of partners to try new ideas, or embrace new lines of thought and others' points of view is essential. Developing this attitude is an important aspect by which to build trust.
- **Sharing of expectations among partners** – Partners will likely enter a collaboration with different expectations about the outcome. If these expectations are not discussed initially, there is a

good chance that some partners will be unsatisfied along the process. This can negatively affect the collaboration.

- **Recognizing the different roles, objectives and needs of partners** – An open dialogue about roles, objectives, and needs among the partners is an important part of building trust, and developing an understanding of each other's prerequisites for entering a collaboration.
- **Finding the right level of complexity in the collaboration** – To identify a good balance in a collaboration it is necessary to avoid fatigue from processes that are too complex or too shallow. There is an inherent risk of missing potential outcomes of the collaboration.
- **Endurance/persistence** – All of the above points require resources in terms of time. Recognizing and allowing for this is an important aspect for successful collaborations.

Collaboration is all about mutual benefits for the partners involved

- **Recognizing complementary abilities and skills in partners** – The strength in collaboration lies in what can be achieved by integrating partners with different abilities and skills. This integration can bring to light insights that challenge established conceptions and result in novel perspectives. Enabling this potential requires that the complementarity among the partners is identified and recognized.
- **Jointly formulated goals/questions/challenges** – Ideally, all partners contribute to define the common goals in the collaboration. An opposite situation, where goals/challenges are pre-determined, might jeopardize the potential of the collaboration by not fulfilling objectives and expectations among the partners.
- **Include all partners from the start** – This relates to the two points above, and aims at making full use of the potential in a constellation of partners. This inclusiveness relates to understanding each other and finding/developing a common ground for the collaboration.
- **Joint/shared responsibility/ownership** – For a successful collaboration it is necessary that the partners come to work as an integrated group with a shared responsibility and a sense of co-ownership for the process. This favors achieving most of the points above.

The beneficial effects of collaboration for scientific quality

Although hallmarks of successful collaboration are the mutual benefits among involved partners, this section focuses specifically on effects of collaboration that stimulate and develop scientific quality. Many of the effects can, of course, be generalized to identify beneficial aspects found also among non-academic partners. The thematic grouping of effects is based on a report from the Swedish governmental funding agency, Vinnova¹.

The UoAs were asked to comment in general on the benefits of collaboration for scientific quality, but there was no specific question box to fill in about this issue in regard to the UoAs in the report form that the review panels filled in. Therefore, it is the answers by the UoAs in their self-assessments, synthesized below that form the basis of a discussion on the benefits of collaboration for scientific quality. We also include relevant comments from the review panel reports.

- **Resource effects** – Some of the UoAs raise the fact that the collaborative activities have resulted in financial support from external actors to support research costs. Another example of a resource effect is that research groups gained access to research infrastructures provided by the external partners. The resource effects are, however, among the least-frequent effects that the UoAs describe

¹VINNOVA ANALYS, VA 2014:09, Universitets och högskolors samverkansmönster och dess effekter (Perez Vico, E., et al.).

in their self-assessments.

- **Competence/learning effects** – In the UoAs’ descriptions on how collaboration with external actors have contributed to develop the research within the group, many attested to how the external influences have generated new ideas and have helped identify knowledge gaps within their field. Knowledge transfer and mutual learning were often raised as important outcomes of the collaborative activities. These effects were commonly mentioned in combination with other effects, e.g. *“knowledge transfer led to an increased understanding of the external partners challenges and the identification of new research question relevant for the sector, and also generated new financial resources that enabled the implementation of the research”*.
- **Guidance effects** – These were, together with competence/learning, the most frequently mentioned effects. The outcome was in various ways described as a change, or as an expansion in the scope of research. Collaborative activities resulted in, for example, increased relevance of the research by addressing challenges that external actors presented. They also led to new perspectives, which could challenge existing perceptions, and lead to a more “systemic” view on one’s own scientific field.
- **Network effects** – The described beneficial consequences of being part of different networks with external actors were numerous, ranging from access to business intelligence, access to competence, increased mobility between academia and industry, shorter paths between research results and societal impact, promoting trust in science, and increased motivation for actually making a difference. The networks were also often described as essential for achieving effects other than those described above.

Challenges in collaboration with non-academic partners

The expert reviewers in their panel reports commented on important challenges to consider when collaborating with external partners. Additional challenges have also been identified through the collaboration case-studies that were designed to describe a collaboration that did not go as originally planned.

- **Trade-offs in resource allocation between collaboration and research** – Both reports from the review panels and the UoAs exemplified the need for a collaboration strategy. Given limited amounts of time, staff, and funding, the research groups have to find a good balance in what they engage in so as to not jeopardize their fundamental tasks of education and research. A few UoAs were assessed as having too much on-going collaborative activity, potentially at the expense of their scientific development.
- **Scientific integrity** – In collaborations with industry or other enterprises, some UoAs emphasize the importance of scientific independence and objectivity, and the ability to freely choose research questions and methods. *“The results of our research are objective and not negotiable or adjustable, according to stakeholders’ expectations and requirements”*. A research group discussed that one of their important roles in a collaborative effort was to challenge if the question at hand was the right one, or if the question needed to be reformulated for a scientific approach.
- **What if the results are not accepted or are uncomfortable for the external partners?** – A few examples raised by the UoAs were related to unrealistic expectations from external actors, and possibly to a lack of understanding of the scientific process. These examples included situations where the results did not meet the partners’ expectations, or even could have negative consequences for the external actors. The importance of an initial dialogue about possible outcomes and consequences was emphasized.

- **Agreements on Intellectual Property Rights** – To formalize collaborations with agreements or contracts can sometimes be of importance. A written document was found to promote the necessary dialogue on the responsibilities, objectives, and expectations among the involved partners. As an academic partner, a written agreement could also ensure that the results from the collaboration could be used for scientific publication, and when applicable, protect the owner-rights to innovations or products.
- **Collaborations that are dependent on specific individuals** – Collaboration activities not rarely fail because a specific individual from one actor is given other duties within an organization, or leaves for a new employment. Suggestions on possible solutions to circumvent the individual-based dependencies in a collaboration were to establish organizational commitment among partners, possibly through agreements. Establishing development strategies for collaboration within research groups or departments can avoid that activities are dependent on specific individuals.

5 RECOMMENDATIONS

Many of the recommendations raised by the expert reviewers during the Q&I 2018 evaluation are most suited to be dealt with at the level of research group, department, or faculty, respectively. Among the recommendations relating to the university level, the Q&I 2018 project group have identified the following as the most important:

- Brand SLU as a sustainability leader – nationally and internationally – and utilize the United Nations Sustainable Development Goals as a framework.
- Make SLU's mission visible and recognizable, and use a common framework to broadcast/disseminate SLU's research results.
- Market SLU as a provider of evidence-based results for policy and decision support, nationally, within EU and globally.
- Develop the social sciences, allowing this scientific field to obtain a critical mass.
- Promote the integration of social sciences and natural sciences. Ensure that interdisciplinary initiatives are developed on equal terms.
- Provide incentives for impact and collaboration – ensure that relevant infrastructures and a merit system are in place.
- Establish an international advisory board to support SLU strategic processes.
- Stimulate and promote high-risk research projects. Stimulate and facilitate SLU researchers to step up as leaders in international projects.
- Use the Future Food platform to clarify the overall SLU strategy for future research and societal impact within food-related science.
- Establish a strategy for better utilization of infrastructure and data from SLU's research, long-term breeding, field trials and Environmental Monitoring and Assessment, by the scientific community as well as society.
- SLU Management should consider if the university organizational structure is optimal for internal collaboration and resource efficiency.
- Develop various aspects of SLU's academic leadership.

6 IMPLEMENTATION

The Quality and Impact 2018 research evaluation is well suited to constitute a component in an upcoming comprehensive model for quality assurance at SLU. This model will be subject to the review to be conducted by the Swedish Higher Education Authority (UKÄ) as a part of their new governmental assignment. The Q&I evaluation model as such, as well as the results from the evaluation, will constitute a baseline for SLU's further strategic work to improve quality of research and societal impact. The digital platform constructed during Q&I 2018 enables collection of data useful for recurrent follow-up and quality assurance. The insights gained from the panels' comments and recommendations provide a valuable basis for strategic measures to be taken at UoA, department, faculty and university levels. They will also provide a natural starting point for the process leading up to the next university-wide strategy.

7 “LESSONS LEARNED” FOR FUTURE EVALUATIONS

The Quality and Impact 2018 evaluation was designed to assess research groups, that is to say, the organizational level that works most closely with the core research mandate of SLU. The process of deciding to which unit of assessment a researcher would belong engaged virtually every person in the evaluation. The groups were to be functional research units and were formed by the Heads of Departments after discussion with researchers. A few factors made the groupings difficult. One was that UoAs were to be from one department and one faculty. This meant that in some cases, research groups who work with similar research questions from different perspectives (different faculties) were not allowed to be assessed as one unit. This may have resulted in lost opportunities for interdisciplinary strategic planning, and that the panels were not able to get the full picture of the research being conducted.

Another factor was that only persons who had SLU as their main employer (worked at least 50% at SLU) were included in the evaluation. This caused research groups who have staff working less than 50% at SLU to feel that they were not adequately represented in the evaluation. Additionally, a few groups with very specific areas of science consisting of less than seven PhDs, were forced to form a UoA with another group of researchers from a closely-related but different area of science. This may have resulted in poorer assessments of the UoA's strategic planning for these “artificial” groups.

An important aspect of conducting a research evaluation of this scale is to clearly communicate the aims, methods and plans for dealing with the results. This can lead to a stronger motivation for those involved to engage in the process, which in turn enables the reviewers to obtain a better picture of SLU's research. Future evaluations could consider establishing pathways and means for even better communication between the SLU Management, the UoAs, and Heads of Department.

Even though considerable efforts were made to communicate the principles for organizing UoAs strictly in accordance with their home department and faculty, this appeared to be difficult to understand for the panels as well as for many researchers. With regard to deciding on the organizational structure of the units

of assessment, future evaluations should take this into consideration. One solution to the problem would be to conduct the evaluation according to the organizational structure of the university, i.e. based on the department level, even if one department belongs to two faculties.

The division into the eleven research areas or panels was done so as to accommodate the UoAs that were defined by the Heads of Department together with their researchers. A few of the panels had too many UoAs to review in the short time allotted. Future evaluations should consider the workload of the expert reviewers in terms of number of reports to write (= number of UoAs) and not only in terms of number of total researchers to review.

The Q&I 2018 evaluation included aspects of both impact and capacity for collaboration. It became apparent that not all expert reviewers or all UoAs understood the difference between the two concepts. The expert reviewers did not in all cases answer the questions that were posed about impact and/or capacity for collaboration. Future evaluations are encouraged to be very clear in their definitions of the impact of research and the research group's capacity for collaboration. Given the present great attention to these issues in the Swedish HEI, by the next evaluation there may be a better general understanding of the collaborative process and, perhaps even well-defined criteria that can be used to make a full assessment.

Concerns about funding issues (insufficient core funding for salaries and for establishing higher academic positions, high reliance on external project grants, and the need for new funding sources) were often expressed by the expert reviewers. These problems are common to all Swedish universities and can be tackled successfully only on a national level. The panels appeared to have spent a great deal of time and effort trying to grasp the legalities of Swedish higher-education employment and the research financing systems. They also struggled to understand decision processes and career paths at SLU. To avoid unnecessary focus on such issues in future evaluations, a detailed briefing of all experts at the outset is recommended.

Recommendations from the Q&I 2009 evaluation were to improve the SLU operational data and to improve the publication database. With regard to the operational data, in the 2018 evaluation it was not technically possible to provide a detailed financial accounting for the units of assessment. Instead, the expert reviewers got information about the funding situation for the department to which the UoA belonged. If future evaluations want to portray the financial status of the research group they are assessing, then a change must be made so that accounts for the unit are available. Alternatively, change the unit to be assessed; make it to be on the level for which SLU can provide detailed financial data.

With regard to the SLU publications database (SLUPub), considerable effort went into making an accurate database over all SLU research publications, books, book chapters, and reports of various kinds. If SLU can continue to make SLUPub a living archive for all the publications with an SLU address, then future evaluations will greatly benefit. A common request from the expert reviewers was that they would have liked to have links to the personal CVs of all members of the UoAs.

The panel hosts gave invaluable contributions to the Q&I 2018 process. We recommend that this function be incorporated into the design and planning of future research evaluations. This would enable the panel hosts to assist their panels in an even more efficient way. It may also be wise to clarify to which extent the panels may expect support from the hosts during the preparations for the actual panel week.

ACKNOWLEDGEMENTS

The Quality and Impact 2018 research evaluation was built upon the efforts of many people at SLU. Besides all the members of the research groups and the support they got from people in their home departments, the following people made significant contributions to the process.

Expert reviewers

Ninety-nine external experts from 17 countries and 76 different organizations were associated with the evaluation. Their names and their affiliations are in Appendix 2.

The Steering Committee

Vice Chancellor's group: Vice Chancellor Peter Högberg, Deputy Vice Chancellor Karin Holmgren, Pro Vice Chancellors: Kevin Bishop, Erik Fahlbeck, Ylva Hillbur, University Director Martin Melkersson and Deputy University Director Birgitta Wikmark Carlsson.

Reference Group

Faculty of Forest Sciences - Dean Göran Ståhl and Senior Research Advisor Thomas Palo. Faculty of Landscape Architecture, Horticulture and Crop Production Sciences - Dean Håkan Schroeder and Senior Research Advisor Tomas Österman. Faculty of Natural Resources and Agricultural Sciences - Dean Torleif Hård, and Senior Research Advisor Marnie Hancke. Faculty of Veterinary Medicine and Animal Sciences - Dean Kristina Dahlborn and Faculty Director Magnus Rosenquist.

Expert competences

Katarina Eriksson (Controller, Division of Planning), Gunnar Ståhl (System Developer, Division of IT), Marie Stråhle (Senior Librarian), Alejandro Engelmann (System Analyst, Library), Joakim Ögger (Controller, Division of Planning), Olof Ingesson (Statistician, Division of Planning), Anita Olofsson (Financial Systems Manager, Division of Financial Administration), Lars Thorell (Chief Controller, Division of Planning), Personnel at the Division of Human Resources, Lisa Cunningham and Johan Häggglund (IT Consultants from BusinessVision), Lotta Hansson (Research Education Director, Division of Planning), Tina Sjöström (Gender mainstreaming project, Division of Planning), Nils Larsson (Technician, Division of IT). In addition, we thank the many coworkers in each division mentioned above that contributed to the evaluation process.

Panel hosts

Agricultural and Horticultural Production: Ann-Sofie Morén; Animal Health: Olle Håstad; Animal Sciences: Lotta Jäderlund; Aquatic and Terrestrial Sciences: Fredrika von Sydow; Economics, Business and Management, and Statistics: Thomas Palo; Forest Management: Lars Erik Lindell; Genetics, Molecular Biology and Physiology: Sofia Wretblad; Molecular Sciences, Biomaterials & Technology: Tomas Österman; Nature and Society: Kristina Julin; Plant Protection: Joakim Ögger; Soil and Environmental Sciences: Helena Eklund Snäll.

Project group

Carolyn Glynn (Senior Advisor, Project Leader), Niklas Nordquist (Senior Research Advisor, Division of Planning), Boel Åström (Head of Unit, Division of Planning) and Tarja Onegård (Administrative Support, Poolia).

APPENDIX

Links to instructions and templates for the Quality and Impact evaluation can be found here:

Quality and Impact documents can be found here:

<https://internt.slu.se/qi2018>

1. Panels and Units of Assessments (UoA)
2. Expert reviewers and their organizational affiliations
3. Evaluation instructions for expert reviewers
4. Self-assessment template for UoAs
5. Bibliometric analyses descriptions
6. Research evaluation report template
7. Overview reports of research fields
8. Unit of Assessment scores
9. Review panel reports for all UoAs

Links to SLU strategic documents

<https://internt.slu.se/en/organisation--styrning/governing-documents/Internal-governing-documents/Visions-and-overarching-strategies/>

PHOTOS OF THE REVIEW PANELS

Agricultural and Horticultural Production



Back row from left: Ann-Sofie Morén (Panel Host), Ep Heuvelink (the Netherlands), Peter Braun (Germany), Hans-Peter Kaul (Austria), Pirjo Makela (Finland), Jørgen Eivind Olesen (Chair, Denmark). Front row from left: Marie-Christine VanLabeke (Belgium), Eva Anflo (Sweden), Stina Olofsson Sweden) Silvana Nicola (Italy).

Animal health



Back row from left: Olle Håstad (panel host), Olli Peltoniemi (Finland), Bruno Goddeeris (Belgium), Peter Kallings (Sweden). Front row from left: Outi Vapaavuori (Chair, Finland), Olav Østerås (Norway), Bryan Charleston (UK), Birgit Nörrung (Denmark), Kicki Gustafsson-Berger (Sweden), Maria Lundvall (Sweden), Anne Elisabeth Torgersen (Norway).

Animal Sciences



Back row from left: Azage Tegegne Wolde (Ethiopia), Sinclair Mayne (UK), Johann Sölkner (Austria), Jaap van Milgen (France), Henner Simianer (Germany). Front row from left: Anna Valros (Chair, Finland), Merete Fredholm (Denmark), Lotta Jäderlund (panel host).

Aquatic and Terrestrial Ecology



Back row from the left: Fredrika von Sydow (Panel Host), Daniel Ligné (Sweden), Richard J. Norby (USA), Mark S. Boyce (Canada). Front row from the left: Leena Nurminen (Finland), Elisabeth Andersson (Sweden), Uta Berger (Germany), Kaisa Junninen (Finland), Phil Levin (Chair, USA). Missing in photo: Michael Baguette (France).

Economics, Business and Management, Statistics



Back row from left: John Shutske (USA), Jarkko Niemi (Finland), Gerard McElwee (UK), Bo Jellesmark Thorsen (Chair, Denmark), Eirik Romstad (Norway), Front row from left: Richard Franklin (Australia), Kristina Mattsson (Sweden), Thomas Palo (panel host), Anne Toppinen (Finland), Maria Landgren (Sweden), Bridget Behe (USA).

Forest Management



From the left: Brett Butler (USA), Ola Kårén (Sweden), Emil Cienciala (Czech Republic), Anders Eira (Norway), Lars Erik Lindell (SLU), Mark Johnston (Canada), Pavel Grabarnik (Russia), Tuija Sievänen (Finland). Missing in photo: Margaret Shannon (USA)

Genetics, Molecular Biology and Physiology



From the left: Sofia Wretblad (Panel Host), Silke Robatzek (Germany), Jaakko Kangasjärvi (Finland), Joana Falco Salles (the Netherlands), Gunnar Jansson (Sweden), Marja Makarow (Chair, Finland), Richard Visser (the Netherlands), Molly Jahn (USA), Christer Andersson (Sweden).

Molecular Sciences, Biomaterials and Technology



From the left: Christine Foyer (UK), Lene Jespersen (Denmark), Ulla Holst (Sweden), Lennart Wikström (Sweden), Stéphane Guilbert (Chair, France), Thomas Österman (Panel Host), Anne Helander Kenne (Sweden), Nils Hannerz (Sweden), Josefin Ahlqvist (Sweden), Margareta Björklund-Sänkiahö (Finland).

Nature and Society



From the left: Gary Evans (USA), Helena Bjarnegård (Sweden), Anders Sjölund (Sweden), Barbara Willard (USA), Mikael Hildén (Chair, Finland), Niklas Cserhalmi (Sweden), Kine Halvorsen Thoren (Norway), Kristina Julin (Panel Host). Missing in photo: Susanna Hecht (USA).

Plant Protection



From the left: Claude Plassard (France), Göran Magnusson (Sweden), Joakim Ögger (Panel Host), Agneta Sundgren (Sweden), Richard Hamelin (Canada), Monica Höfte (Belgium), Heikki Hokkanen (Finland), Jan Jensen (Sweden), Sarah Gurr (Chair, UK).

Soil and Environmental Sciences



From the left: Klaus Katzensteiner (Austria), Helena Eklund Snäll (Panel Host), Anna Jöborn (Sweden), Rajiv Koshla (Co-chair USA), Lillian Øygarden (Norway), Åsa Moberg (Sweden), Hana Santruckova (Co-chair Czech Republic), Carl-Göran Pettersson (Sweden), Rick Hooper (USA), Wim Cornelis (Belgium), Miriam Diamond (Canada), Rob Comans (the Netherlands).