Evaluation of Quality and Impact at SLU

KoN09

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QUALITY AND IMPACT – GUIDANCE FOR THE FUTURE

The Swedish University of Agricultural Sciences, SLU, has a unique mission amongst Swedish universities, which is to advance knowledge about biological natural resources and mankind's management and sustainable use of those resources. In order to stay internationally competitive, SLU needs to continually strive for excellence in the quality of its research and environmental monitoring and assessment. Another key issue for SLU is its collaboration with industry and other public and private stakeholders in sectors such as agriculture, forestry, veterinary medicine, landscape planning, environment, etc. The evaluation 'Quality and Impact' focuses on both these aspects. It highlights SLU's strengths as well as suggests action for improvement. The results are in general very positive for SLU and I am convinced that they will be of great value in our continuous work to improve quality and impact in order to meet our vision – that SLU is a world class university in life- and environmental sciences.

Uppsala, December 2009

Lisa Sennerby Forsse
Vice-Chancellor, Swedish University of Agricultural Sciences

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PREFACE

The Swedish University of Agricultural Sciences (SLU) is a sectoral university with responsibility for forestry, agriculture, veterinary medicine, landscape architecture and landscape planning, covering natural and social sciences, veterinary medicine, technology and humanities. The general trend in Europe and elsewhere is to allocate funding for research based on quality and performance. This necessitates competition between universities for public and private funding. External evaluations, as well as national and international ranking systems, are becoming increasingly important, and like other universities, SLU must adapt to this new environment. Much has happened since the previous evaluation of SLU was made in 1991, including a major reorganisation starting in 2004 and further scientific development. This has transformed SLU from an organisation focusing largely on applied science and extension services to a modern university with the emphasis on basic and applied research.

The objective laid down by the Board of SLU in initiating a large-scale evaluation was to gain a clear indication of the strengths and weaknesses of SLU research in an international perspective. This should form a basis for strategic decisions on development of the University to improve its quality as well as impact and utility, and thus its future competitiveness. In planning the SLU evaluation, it was an advantage for us to gain access to the experience of other universities in Sweden; Uppsala University, Lund University, and in particular the Royal Institute of Technology (KTH). Professor Joseph Nordgren and Dr Emma Källblad have generously shared their experience of the evaluations recently performed by Uppsala University and KTH, respectively. These discussions provided inspiration and many valuable suggestions during the planning of KoN.

Since SLU is a sectoral university, focusing on the green sectors, there were lengthy discussions about how to proceed to obtain external opinions from various stakeholders about the impact and utility of an entire university. Put simply, what "use" does the surrounding world derive from a sectoral university? It was decided that the SLU evaluation should include these aspects as a separate part of the evaluation. For this part we had no guiding experience from other universities, since, as far as we know, this is the first time an evaluation of utility and impact has been performed on this scale. It will soon become evident whether the utility and impact element of the evaluation is a valuable tool in SLU's further development, but as one Scientific panel put it:

"There is no contradiction between high quality of basic research and high external impact and utility"

The most intensive phase of the evaluation process began in May 2009, when the international expert panels met in Uppsala, followed by the stakeholder panel meetings in late June. Before then, the entire University administration, as well as Faculties, departments, research teams and individual researchers, were deeply involved in planning and making self-assessments. The whole process has certainly met with hurdles along the way, but overall we consider the KoN evaluation to have been very successful. The results presented in the reports by the expert and stakeholder panels are clear: SLU has great strengths, but also some weaknesses. Some results were expected; some probably came as a surprise.

The basis for developing SLU has been laid, but the KoN evaluation cannot end here. Considerable effort and resources have been expended and now it is up to University and Faculty management, departments, and individual Units of Assessment to implement the recommendations within the framework of that which is feasible. A wealth of experience has been obtained

during the KoN process, experience that will be of use when the next evaluation is carried out in four or five years' time. SLU education as such was not scrutinised in the KoN evaluation, but a number of positive and valuable comments and recommendations were made that will also benefit development of our education programmes.

The KoN evaluation has been a major task, which would not have been possible without the involvement of a large number of dedicated individuals and organisations. We are particularly grateful to the following:

• Scientific panels • Stakeholder panels • Interviewees • FBA Holding AB •

• Assoc. Prof. Ulf Sandström • Academic Conferences • Mr. Maxwell Arding • The SLU Libraries •

• Panel hosts and secretaries • The Controller Unit • The KoN Planning Committee •

• Other contributors from the university, faculty and departmental administrations •

Last, but not least, all SLU scientists, who have put a great deal of time and effort into the preparations for KoN.

For the KoN Management Team, it has been a most stimulating challenge to plan and perform the evaluation, to analyse the results and present recommendations for action at various levels of SLU. We consider the KoN evaluation to have been carried out as thoroughly and as fairly as possible. We hope that the results of KoN will be of great value in further development of the many dimensions of a strong university, within the university itself and in relation to stakeholders and other partners.

Alnarp and Ultuna, 1 December 2009

Roland von Bothmer
Director
The KoN Management Team

Johan Schnürer
Deputy Director
The KoN Management Team

EXECUTIVE SUMMARY

Background and objectives

In April 2008 the Board of the Swedish University of Agricultural Sciences (SLU) initiated a comprehensive evaluation of SLU's research and environmental monitoring and assessment (Foma). The Quality and Impact (*Kvalitet och Nytta*; "KoN") evaluation was intended to cover scientific quality as well as relevance and impact, i.e. the benefits to society and industry. The aim was to make an in-depth assessment of the standing of SLU's research in an international perspective and visualise the synergies between research and Foma. The evaluation was to constitute the basis for strategic decisions at various levels of SLU.

The Process

The evaluation comprised two main elements: Examination of scientific quality and relevance performed by peer review, and examination of the impact and utility of the research performed by external assessors from a user perspective.

The focus of the scientific evaluation was the Unit of Assessment (UoA), i.e. research teams in a department. A total of 130 UoAs in 15 research fields were assessed by 15 Scientific panels, each made up of 3 – 7 international experts, and 1 – 2 (mainly Swedish) stakeholder representatives. The four criteria Scientific Quality, Recognition and Leadership, Relevance and Impact, and Strategy and Potential were evaluated. Each criterion was evaluated on a scale of 1 – 6 (poor – world leading). Assessments were based on the UoAs' written self-assessments, bibliometric analysis, and interviews. Each panel produced a report, including scoring of the UoAs, general and specific comments and recommendations.

The impact and utility evaluation took the form of in-depth interviews with 28 selected stakeholders, and a subject-oriented evaluation made by five Stakeholder panels with 5 - 8, mainly Swedish participants. The premise was to view SLU from a user perspective, i.e. how stakeholders perceive the quality of SLU. The five stakeholder panels were: Food; Animal Health and Welfare; Raw Materials for Energy and Industry; Spatial Planning, Environment and Nature; Environmental Monitoring and Assessment (Foma). In their reports, the panels commented on the four evaluation criteria: Technical Quality and Relevance, Functional Quality, SLU's Image, and Future Challenges.

Results and Analysis

Research quality is generally considered to be good at SLU. However, in most research fields there is a considerable variation in performance between units.

With regard to Scientific Quality, 67% of the UoAs are considered to be "internationally recognised" or better and 7 % of the UoAs "world leading". The highest scores were awarded for Relevance and Impact, with 75% of UoAs receiving scores of 4 or above. The strongest research fields at SLU, taking account of all four criteria, are: Plant Science; Plant Protection; Ecology and Environmental Sciences; Chemistry, Molecular Biology and Microbiology; Forest Management and Products; Genetics and Breeding.

The higher ranked units are generally found in the fields of more fundamental science, often involving a combination of curiosity-driven and needs-driven research. In applied fields of research, many units are of reasonable quality, but certain SLU profile areas require attention to improve both scientific quality and the value provided for stakeholders and society.

Some of SLU's strengths identified by the Stakeholder panels are: SLU is independent, with a high level of integrity; it offers knowledge at a high level and represents an important recruitment base for stakeholders. The level of utility is high, and joint projects between individual stakeholders and research teams mostly work very well. Some of the weaknesses are that SLU is not sufficiently visible in the community and there is too much focus on problems and too little on solutions. Impact would be enhanced if SLU adopted a holistic approach when presenting research activities and overviews of current knowledge.

Scientific and Stakeholder panels alike were impressed by the value of Foma to society. Many units were praised for having very high relevance and impact for policy makers. Scope for developing new dimensions of Foma was identified. The unique data generated by Foma should be utilised to a greater extent in research. Stakeholders consider Foma to have good technical quality and that programmes are carried out with great commitment and professionalism. However, SLU needs to enhance Foma's visibility and more frequently publish well-balanced reports on which to base decisions, as well as increase data availability.

The evaluation provides SLU with a valuable foundation for decision-making at all levels at the university. Even though the two panel categories had different *modus operandi*, their conclusions were surprisingly similar. Scientific and stakeholder panels both stressed that good and sound scientific performance is a prerequisite for the application of results in industry and society (*"Doing the one is no excuse for not doing the other"*). Other general conclusions are that SLU's research and Foma are fragmented into too many small and indistinct units and programmes, and a lack of strategic thinking and planning contributes to suboptimal visibility and image.

Recommendations

In order to strive for high quality and enhanced impact and utility, SLU should improve the following areas:

- Scouting and analyses of the future surrounding world, by establishing various 'think tanks'
- Strategic thinking, including offering advanced training courses for senior management
- Academic leadership by way of courses, training and seminars
- Succession planning should be substantially improved, together with an improved process for filling leading positions
- Focus on research/ profile areas; SLU should concentrate on fewer areas and more clearly include major global and national challenges and indentify important profile areas
- Collaboration and synergies; larger research units should be created to reduce overlaps and increase synergies; collaboration with neighbouring universities should be substantially deepened; strategies for better utilisation of Foma data in research should be developed
- Intellectual infrastructures and technology platforms; new virtual or physical meeting places should be formed; joint technology platforms should be provided in statistical consultation, bioinformatics; mathematical modelling; systems analysis; and "omics"
- Communication and outreach; a communication strategy defining priority areas should be established; courses and education in communication should be provided; open conferences should be held on topical matters; priority should be given to extension service positions
- International links; a framework for sabbaticals and international training should be developed and an arena created for inviting experienced, international scientists to come to SLU; Foma should broaden its international scope by increasing involvement in international collaboration
- Activities in developing countries should be strengthened and a platform for efficient coordination should be established.

A number of comprehensive recommendations regarding overlaps and potential synergies between specific research teams (UoAs), departments, faculties and centres at SLU, and relationships with other universities within and outside Sweden are presented. Some research fields are in need of reinforcement and some organisational steps, such as amalgamation of certain units, are necessary.

Four Research Areas for the Future

Global challenges and national needs both underscore the importance of intensified research, combining the strengths of all four faculties at SLU. Based on the conclusions and recommendations presented above, the creation of four broad research areas is proposed: *Future Forest, Future Agriculture, Future Animal Health and Welfare*, and *Man in the Future Environment*. This model concept would provide an opportunity for all SLU research units to find a place within a larger scientific framework.

The four areas will constitute interdisciplinary platforms for a number of joint activities such as internal and external interaction, coordination of research projects, and formulation of major grant proposals. They will constitute power bases enabling SLU to adopt a strong role as coordinator of national and international research programmes. The organisation of SLU in faculties and departments provides the necessary academic disciplinary structure, while the Four Research Areas for the Future will constitute a dynamic matrix organisation.

Implementation

There are extraordinarily high expectations internally at SLU and among interested stakeholders outside the University that the results of KoN will lead to visible changes. All levels of organisation at SLU have been deeply involved in KoN, and all levels should also be involved in implementing the outcome.

Each defined research team should continue to pursue strategic development in the light of KoN recommendations. At departmental level, all individual scientists should be included in active research teams. In cases where there are activities in the same research field, coordination across organisational borders will be required. Many recommendations require consideration at faculty and university level, such as those concerning leadership, comprehensive strategic planning, communication, etc. A deeper and continuous dialogue with stakeholders is vital; provision of extension services and a strengthened scientific focus seem particularly important.

It is suggested that the next KoN evaluation should be carried out in 4 to 5 years' time, preceded by a simplified internal and mid-term review on how KoN recommendations have been implemented.

SAMMANFATTNING

Bakgrund och syfte

Styrelsen för Sveriges lantbruksuniversitet (SLU) beslutade i april 2008 att låta genomföra en heltäckande utvärdering av SLU:s forskning och fortlöpande miljöanalys (Foma). Utvärderingen Kvalitet och Nytta (”KoN”) skulle omfatta såväl vetenskaplig kvalitet som relevans och nytta, dvs. betydelsen för näringar och övriga samhället. Syftet var att göra en djuplodande granskning av hur SLU:s forskning och Foma står sig i ett internationellt perspektiv, samt att belysa synergierna mellan forskning och Foma. Utvärderingen skulle förse SLU med underlag för strategiska beslut på olika nivåer inom universitetet.

Processen

Utvärderingen omfattade två huvudkomponenter: Bedömning av vetenskaplig kvalitet och relevans med hjälp av sakkunnigbedömning (”peer review”) samt bedömning av nytta ur ett användarperspektiv utförd av SLU:s intressenter (näringar, myndigheter, intresseorganisationer, etc.).

Den vetenskapliga utvärderingen fokuserades på forskargruppsnivån. Totalt 130 forskargrupper, fördelade på 15 forskningsområden, granskades av 15 vetenskapliga paneler. Dessa bestod av 3 -7 internationella forskarrepresentanter samt 1-2 vetenskapligt meriterade relevanspersoner, som representerade fr.a. svenska intressenter. De fyra bedömningskriterierna var: Vetenskaplig kvalitet, Internationellt erkännande och ledarskap, Relevans och genomslag (nytta), samt Strategi och potential. För varje kriterium gjordes en betygssättning enligt en skala från 1 (svag) till 6 (världsledande). Bedömningen gjordes på grundval av forskargruppernas skriftliga självvärderingar, bibliometrisk analys (dvs. publiceringskvalitet) samt intervjuer med forskargrupperna. Varje panel formulerade en rapport innehållande betygssättning, specifika kommentarer och rekommendationer för varje forskargrupp, samt ett omdöme för hela forskningsområdet.

Utvärderingen av nytta genomfördes dels i form av djupintervjuer med 28 utvalda intressenter, dels genom övergripande, områdesvisa analyser som utfördes av fem intressentpaneler med vardera 5-8 personer, merparten från Sverige. Utgångspunkten var att värdera SLU:s nytta utifrån ett intressentperspektiv, dvs. hur intressenterna uppfattar SLU. Panelområdena valdes utifrån fem tillämpningsområden som är centrala för SLU: Livsmedel (jord- och trädgårdsbruk, husdjur, vattenbruk); Djurhälsa och djurvälfärd; Energi- och industriråvaror (fiber, virke, energi, mm); Samhällsplanering, miljö och natur; samt Fortlöpande miljöanalys (Foma). Panelernas rapporter omfattade de fyra bedömningskriterierna: Teknisk kvalitet och relevans, Funktionell kvalitet, SLU:s image, samt Framtida utmaningar.

Resultat och analys

SLU:s vetenskapliga kvalitet bedöms generellt vara hög. Inom varje forskningsområde finns dock en stor spridning mellan forskargrupper.

Sett till vetenskaplig kvalitet bedöms 67 % av forskargrupperna hålla minst “internationellt erkänd” standard, och 7 % bedöms vara världsledande inom sina områden. Bäst bedömning fick SLU på kriteriet Relevans och nytta, där 76 % av grupperna fick betyget 4 eller högre. Vid en sammanvägning av alla bedömningskriterier är SLU:s starkaste forskningsområden: Grundläggande växtvetenskap, Växtskydd, Ekologi och miljövetenskap, Kemi, molekylärbiologi och mikrobiologi, Skogsbruk och skogsprodukter, samt Genetik och förädling.

De mest framstående forskargrupperna återfinns mestadels inom områden av mer grundläggande karaktär, och har ofta lyckats kombinera nyfikenhetsbaserad och behovsanpassad forskning på ett fruktbart sätt. Inom mer tillämpade områden håller många grupper godtagbar kvalitet, men det finns viktiga profilområden där SLU bör vidta åtgärder för att stärka såväl den vetenskapliga kvaliteten som forskningens nytta för intressenterna.

Nyttobedömningen lyfte fram att SLU uppfattas som en oberoende organisation med hög integritet, som erbjuder en hög kunskapsnivå och utgör en viktig rekryteringsbas för intressenterna. SLU:s nytta bedöms vara stor och samverkansprojekt mellan näring (i vid mening) och olika forskargrupper fungerar i de flesta fall mycket väl. Som svagheter nämns att SLU är alltför osynligt i samhället och att forskningen har för stort fokus på problem och för lite på lösningar. Genomslagskraften skulle öka om forskningen i större utsträckning bedrevs utifrån helhetssyn och systemtänkande, samt presenterades på ett mer användaranpassat sätt.

Både de vetenskapliga och intressentpanelerna imponerades av Fomas stora samhällsbetydelse. Många Foma-grupper lovordades för verksamhetens höga relevans och nytta för beslutsfattare. Bedömarna pekar på flera intressanta möjligheter att bredda Fomas verksamhet ämnesmässigt. Flera vetenskapliga paneler framhöll att de i många fall unika dataserierna från Foma används i alldeles för liten utsträckning inom forskningen. Intressenterna anser att Foma genomförs på ett professionellt och effektivt sätt, och med ett stort engagemang. Samtidigt anser man att datatillgängligheten måste förbättras samt att SLU bör satsa på att öka Fomas synlighet och regelmässigt producera väl balanserade beslutsunderlag.

Utvärderingen har försett SLU med en värdefull grund för strategiska beslut om åtgärder på alla nivåer inom universitetet. De två panelkategorierna har, trots olika utgångspunkter, kommit fram till förvånansvärt likartade slutsatser och betonar att hög vetenskaplig kvalitet är en nödvändighet för att resultaten ska kunna komma till nytta inom näringar och övriga samhället. SLU måste säkerställa en hög vetenskaplig kvalitet i kombination med att aktivt främja samverkan med sina intressenter och samhället i stort: *”Att göra det ena är ingen ursäkt för att inte göra det andra”* (citat från en vetenskaplig panel). Andra generella slutsatser är att SLU:s forskning och Foma-verksamhet ofta är alltför splittrad på små enheter respektive program, och att brister i strategiskt tänkande påverkar SLU:s synlighet och image negativt.

Rekommendationer

För att uppnå en hög kvalitet och förstärkt ”nytta” bör SLU förbättra följande områden:

- Omvärldsspaning och analys av framtida utveckling, bl.a. genom olika tankesmedjor
- Strategiskt tänkande där avancerade utbildningar erbjuds personer i ledande funktioner
- Stärkande av det akademiska ledarskapet genom olika former av utbildning och seminarier
- Planering för återbesättande och nyinrättande av högre tjänster måste förbättras och tillsättningsprocessen effektiviseras
- Forskningsfokus/profilområden; SLU bör koncentrera verksamheten på färre områden och tydligare ta sig an större globala och nationella utmaningar, samt identifiera viktiga profilområden
- Samarbeten och synergier; större forskargrupper bör etableras för att minska överlappningar och öka samverkan; samarbete med närliggande universitet bör fördjupas; strategier för att bättre utnyttja data från Foma inom forskningen bör utvecklas
- Intellektuella infrastrukturer och teknologiplattformar; nya virtuella och fysiska mötesplatser bör bildas; gemensamma kompetensplattformar för statistik, bioinformatik, matematisk modellering, och ”omics” bör utvecklas

- Kommunikation och utåtriktad verksamhet; en kommunikationsstrategi som definierar prioriterade områden bör utvecklas; kurser och utbildning i kommunikation tillhandahållas; öppna konferenser bör organiseras inom angelägna ämnesområden; inrättande av samverkanstjänster bör prioriteras
- Internationellt samarbete; ett system för sabbatsår och internationellt utbyte för såväl yngre som äldre forskare bör utvecklas och möjligheter skapas för att bjuda in erfarna, internationella forskare; Foma bör bredda sitt internationella engagemang
- Verksamhet riktad mot utvecklingsländer bör stärkas och en plattform för effektiv koordinering av denna verksamhet inrättas.

I rapporten presenteras ett stort antal rekommendationer som avser överlappningar och potentiella synergier mellan olika forskargrupper, institutioner, fakulteter och centra vid SLU samt samverkan med andra universitet inom och utanför Sverige. Några forskningsområden är i behov av förstärkning och vissa organisatoriska förändringar, t ex sammanslagning av enheter förefaller nödvändiga.

Fyra Forskningsområden för Framtiden

Globala utmaningar och nationella behov understryker behovet av forskning där den samlade styrkan hos SLUs fyra fakulteter kan utnyttjas. Baserat på ovanstående slutsatser och rekommendationer förslås att SLU kraftsamlar kring fyra breda forskningsområden: *Framtidens skogar, Framtidens lantbruk, Framtidens djurhälsa och välfärd,* samt *Människan i framtidens miljöer.* Denna modell ger alla enheter vid SLU en möjlighet att samverka i ett bredare forskningssammanhang.

De fyra områdena kommer att utgöra tvärvetenskapliga plattformar för flera gemensamma verksamhetsfält, som t.ex. intern och extern samverkan, samordning av forskningsprojekt och utformning av större programansökningar. Områdena kommer att innebära en kraftsamling som gör det möjligt för SLU att ta på sig en framträdande roll som koordinator för stora nationella och internationella forskningsprogram. SLU:s organisation med fakulteter och institutioner utgör den ämnesmässiga och organisatoriska basen medan de fyra framtidsområdena kommer att utgöra en dynamisk matris för vetenskaplig samverkan.

Genomförande

Det finns mycket höga förväntningar såväl inom SLU som bland intressenterna att KoN ska leda till märkbara förändringar. Alla nivåer inom SLU har varit starkt involverade i KoN och bör därför också engageras i förändringsarbetet.

Slutsatserna och rekommendationerna i KoN ger enskilda forskargrupper möjlighet att fortsatt sträva efter en positiv strategisk utveckling. På institutionsnivå bör man eftersträva att alla forskare ingår i funktionella forskargrupper. Vid överlappande verksamhet fordras koordinering över institutions- och fakultetsgränser. Ett flertal rekommendationer, t.ex. rörande ledarskap, strategisk planering på övergripande nivå och kommunikation, kräver överväganden på fakultets- och universitetsnivåerna. Utvärderingen understryker betydelsen av en fördjupad dialog med intressenter, väl fungerande samarbetsformer med näringarna och en ökad vetenskaplig fokusering.

Den breda KoN-utvärderingen, vilken är den första i sitt slag i Sverige, utgör en bra grund för SLU:s utvecklingsarbete. En ny utvärdering bör genomföras om 4-5 år, och bör föregås av en förenklad, intern uppföljning av hur rekommendationerna i KoN har uppfyllts.

ABBREVIATIONS

FBA FBA Holding AB, a consulting company contracted for the evaluation of Impact and Utility

Foma Environmental Monitoring and Assessment (*Fortlöpande miljöanalys*); SLU's third operation alongside research and education

HSV Swedish National Agency for Higher Education

KoN Quality and Impact (*Kvalitet och Nytta*)

KTH Royal Institute of Technology (Kungliga Tekniska Högskolan)

LTJ Faculty of Landscape Planning, Horticulture and Agricultural Science

NL Faculty of Natural Resources and Agricultural Sciences

R&L Recognition and Leadership; one of four assessment criteria in the Scientific evaluation

R&I Relevance and Impact; one of four assessment criteria in the Scientific evaluation

S Faculty of Forest Sciences

S&P Strategy and Potential; one of four assessment criteria in the Scientific evaluation

SQ Scientific Quality; one of four assessment criteria in the Scientific evaluation

UoA Unit of Assessment; roughly equivalent to "research team"

VH Faculty of Veterinary Medicine and Animal Science

1 MISSION AND BACKGROUND

1.1 MISSION

On 17 April 2008 the Board of the University of Agricultural Sciences (SLU) decided to initiate a comprehensive evaluation of SLU's research and environmental monitoring and assessment. This evaluation was intended to cover quality as well as impact, i.e. the benefits to society and to the green sectors, and was accordingly named Quality and Impact (*Kvalitet och Nytta*; in this report, the abbreviation "KoN" is used). The Vice-Chancellor appointed Professor Roland von Bothmer Director and Professor Johan Schnürer Deputy Director of the evaluation, with the task of planning and carrying out the evaluation, and to present the results by the end of 2009.

The KoN project forms part of the University's research and education strategy 2009 – 2012. The aim was to carry out a penetrative and objective examination of the standing of SLU's research and environmental monitoring and assessment against international standards. The evaluation should help SLU to identify research environments that are scientifically strong and/or successful in making a positive contribution in the relevant sectors, as well as those in need of revitalisation. Thus, it should constitute a foundation for strategic decisions at all levels.

1.2 BACKGROUND

1.2.1 A changing research arena

Major changes have occurred at SLU and in the surrounding world over the last five years. Since SLU was restructured in 2004, its four new faculties have been engaged in internal reorganisation, development of their own strategies, campus and action plans. The University as a whole has been discussing overall strategies, strategic projects and the faculties' core subjects as a means of promoting high standards of research. Environmental monitoring and assessment at SLU has been conducted using a partly new approach, incorporated in inter-faculty programmes so as to exploit the synergies between research and environmental monitoring and assessment.

The Government requires that institutes of higher education create a clear profile and concentrate their resources on promoting strong research environments. This means that SLU has a greater need than ever for high-quality data on which to base strategic decisions. The continuing strategic development of the University, its faculties and its departments is heavily dependent on knowledge of the internal scientific quality of the work and the benefit derived from it.

SLU, like other universities, operates in an increasingly competitive market. The report "Resources for Quality" (Swedish Government Official Report SOU 2007: 81) proposed that future government funding be allocated according to the scientific performance of institutes of higher education, evaluation of research being one component in the assessment. In 2009 Sweden introduced a funding allocation system which is partly performance-based. Likewise, private enterprise in many sectors has very good knowledge of the international skills and know-how situation, and chooses to fund research and development projects where they will generate the best return on investments. In this context, an objective scrutiny that enables SLU to clearly understand, develop and market its areas of strength is of great value.

Nationally and internationally, evaluations are an instrument used by many universities and colleges. In 2007 Uppsala University carried out a review of all research ("Quality and Renewal"). That review attracted a great deal of attention in the context of research policy. The result of the evaluation forms the basis for a comprehensive strategic overhaul carried out by Uppsala University, designed to add strength to its most successful areas. The Royal Institute of Technology (KTH) and Lund University have followed, performing similar evaluations in 2008. Another example is Helsinki University, where all research is evaluated on a regular basis. In the United Kingdom, the nationwide system of evaluations as part of the Research Assessment Exercise has formed the basis for allocation of governmental research funds since 1997-98. At SLU, the quality of research in some departments has been evaluated in recent years, but a comprehensive appraisal of all research at the university has not been carried out since 1991.

1.2.2 Purpose and scope of KoN

The aim of the evaluation is to make an in-depth and objective assessment of the standing of SLU's research and environmental monitoring and assessment in an international perspective by evaluating scientific quality, relevance and impact. The evaluation covers research including postgraduate education (with the exception for course work), and SLU's unique operations classified as environmental monitoring and assessment (*Fortlöpande miljöanalys*, abbreviated below as "Foma").

The main focus in SLU's evaluation is on assessment of research quality. However, since SLU is a sectoral university, a significant proportion of its research comprises needs-driven or sector-driven research, and many researchers take a very active part in outreach and support to stakeholders in industry, public authorities, etc. The importance of this work cannot be appraised solely on the basis of traditional, intra-scientific criteria. To gain an overall picture, it was therefore decided that all research should be assessed both for its scientific quality and for its benefit to industry and society in general, and that the assessment of impact should be made from a user perspective. Thus, KoN also asks the question: 'How does the surrounding world see SLU in terms of the benefit produced?' A further objective was to examine the synergies between research and Foma, and how stakeholders perceive SLU's Foma operations.

The emphasis of the evaluation is on describing the strengths, weaknesses and potential of SLU's activities, as well as any threats they face. Prerequisites and factors essential for favourable development are described. One purpose of the evaluation is to identify research environments that are scientifically strong, those with the potential to be scientifically successful, as well as those needing scientific revitalisation. The evaluation should also enable SLU to identify areas that are, or have the potential to be, successful in contributing to positive societal development.

The results of the evaluation are intended to provide guidance for strategic decisions, which may help to improve scientific quality and the impact of SLU's research, thus strengthening SLU's standing. This applies at all levels, from individual researchers to research teams, departments, faculties and SLU as a whole. The evaluation also intends to clarify SLU's areas of strength so that others can identify them as a basis for joint value creation and mutual benefit.

The guiding principle for KoN has been to perform the evaluation in a thorough and responsible way so that all dimensions of basic and applied research are examined, and all units feel that they have been fairly judged. Other central objectives of the evaluation have been: Openness, involvement, commitment, clarity, foresight and efficiency.

2 METHODS

In the following, references are made to Appendices in this volume and Supplements available at http:\\www.slu.se/kon.

2.1 ORGANISATION

An evaluation management team ("the KoN Management Team") consisting of the two scientific Directors (Roland von Bothmer and Johan Schnürer) and three members of the University Administration (Per Andersson, Katarina Vrede, Boel Åström) has been responsible for planning and carrying out the evaluation.

The KoN Management Team has been assisted by a reference group ("Planning Committee"), including the Faculty Vice-Deans of Research, the Assistant Vice-Chancellor of Environmental Monitoring and Analysis, and the Senior Research Officers at the four Faculties. All major decisions taken by the KoN Management Team, such as methodology, assessment criteria and guidelines for the expert panels, and choice of experts, have been made after consultation with the Planning Committee. Matters of principle have also been discussed with the Vice-Chancellor. Throughout the process, the KoN Management Team has submitted regular reports to the SLU Senior Management Team and the University Board. Methods of evaluating impact and utility have been developed in consultation with stakeholders.

The evaluation has been supported during its various stages by the University Administration (the Controller Unit, the IT Unit in Umeå, the Division of Communication, etc.) and the SLU Libraries.

2.2 GENERAL SET-UP

The KoN evaluation comprised two main elements:

i) Examination of the quality and relevance of research, performed by international experts, i.e. peer review ("Scientific panels").

ii) Examination of the relevance and impact of the research, performed by external assessors from a user perspective ("Stakeholder panels", preceded by in-depth interviews with selected stakeholders).

Preparations for the evaluation started in June 2008, and the whole process ended with the completion of this report in December 2009 (Table 1).

2.3 SCIENTIFIC EVALUATION

2.3.1 Definition of research fields and Units of Assessment

Two main principles were followed:

i) In order to take full account of SLU's diversity and specific conditions (e.g., transdisciplinary Faculty and Departmental structure), it was decided to base the scientific evaluation on a disciplinary rather than organisational structure. Fifteen disciplinary-oriented "research fields" were defined by merging research operations within similar areas. The aim was to demarcate these fields to be coherent and of roughly uniform size (Table 2).

ii) To provide sufficient detail in the analysis, the unit to be evaluated on an individual basis was the "research team", referred to in the following as "Unit of Assessment" ("UoA"). Each Head of Department was asked to define UoAs within his or her Department. The principles used varied somewhat. Some UoAs in KoN are formal research teams, others are informal research teams with a natural affinity and common research interests. In some cases, however, UoAs were defined specifically for this evaluation, bringing together solitary researchers who have no real collaboration. The size of the UoAs varied from about 2 to 30 scientists (with PhD degrees).

Thus, the research body evaluated consists of 15 research fields, each with 2 to 15 UoAs, each representing between 2 and 7 departments belonging to between 1 and 4 faculties (Table 2).

2.3.2 Evaluation documents

As a basis for their assessment, the panels were provided with the following documentary material:

i) *Bibliometric analysis of scientific publication*
Each Scientific panel was provided with data on a range of indicators for all UoAs to be assessed, as well as for the research field as a whole. The bibliometric analysis was carried out by Assoc. Prof. Ulf Sandström, consultant in bibliometry. The principles for analysis are described in the Supplement (B 2). The "brain power" approach was used, i.e. only publications by staff employed or otherwise actively working at SLU on 31 December 2008 were included.

Collection of publication data was overseen by the SLU Libraries in collaboration with the University Controller Unit, and included a process in which all researchers were requested to check and validate their publication records in ISI Web of Science, and to upload their other scientific publications in a database. In addition, publications of other kinds were registered in SLU's database for publications. The process of registration and compilation did not work entirely smoothly; hence, the quality of the data varied between UoAs.

ii) *Self-Assessments and operational data*
Each UoA was asked to describe its research profile, Foma activities (if relevant), outputs (both academic and other), and strategy for the future (Supplement B 1). The self-assessment documents included data on staff, funding profile and publication profile. These data were partly provided by University administration, partly by the UoAs themselves. Unfortunately, the collation of operational data met with a number of problems (Chapter 9.5). As a supplement, lists of publications compiled by combining data from the databases described above were included in the documentation provided to the panels.

TABLE 1. *Timetable for the evaluation process*

	2008						2009											
	Apr		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
SLU Board decision																		
Evaluation Management Team established																		
Workshop for stakeholders																		
Preparation of instructions and documents for the evaluation																		
Units of Assessment (UoA) defined																		
UoAs add publications to bibliometric data-bases																		
UoAs write self-assessments																		
Recruitment of Scientific panels																		
Compilation of central data																		
Bibliometric analyses																		
Recruitment of Stakeholder panels																		
Foma units write self-assessments																		
In-depth interviews with stakeholders																		
Evaluation documentation available to the Scientific panels																		
Scientific panels visit SLU																		
Evaluation documentation available to the Stakeholder panels																		
Meeting of Stakeholder panels																		
Panel Reports completed																		
Panel Reports available to SLU staff																		
Final Report presented to SLU Board, and SLU staff																		
Final Report published																		
Start of implementation																		
Final Report presented to stakeholders																		(Jan 2010)

TABLE 2. *Research fields in the scientific evaluation*

No	Designation	No of UoA	No of PhDs	No of Faculties
1	Economics and Statistics	12	66	3
2	Landscape Architecture, Urban and Rural Development	14	87	3
3	Ecology and Environmental Sciences	11	126	3
4	Food Science and Safety	3	33	2
5	Animal Health	12	77	1
6	Animal Husbandry	11	76	3
7	Biomedicine	5	37	1
8	Forest Management and Products	12	105	1
9	Biosystems Technology	9	74	3
10	Plant Protection	10	92	2
11	Plant Production	9	51	2
12	Soil and Aquatic Sciences	8	99	2
13	Plant Science	2	63	2
14	Genetics and Breeding	6	65	4
15	Chemistry, Molecular Biology and Microbiology	5	67	1

2.3.3 Scientific panels

A panel, consisting of 3 – 7 highly experienced and recognised scientists in the research field, and two highly competent stakeholder representatives with scientific backgrounds, was appointed for each research field (Appendix 1). One of the scientists on the panel was appointed chairperson. Scientific panel members were recruited from abroad to ensure that SLU's research was evaluated in the light of international advances. The stakeholders, mainly Swedish, were required to have a broad overview of the needs of industry, authorities and/or society in general in Sweden.

Researchers at SLU were invited to suggest scientific evaluators. More than 400 people were suggested. The composition of the panels was discussed with Faculty representatives (Vice-Deans and Research Officers). The Faculty representatives also suggested potential stakeholder representatives for the panels. Panel composition was formally decided by the Vice-Chancellor. To avoid conflicts of interest, the evaluators were asked to sign a form entitled "Impartiality and confidence in the evaluation Quality and Impact (KoN)".

2.3.4 Evaluation criteria and process

SLU has endeavoured to define a versatile set of assessment criteria that best describe the multidisciplinary excellence required of a sectoral university. The assessment system adopted for this purpose was particularly influenced by the system developed by KTH (the Royal Institute of Technology), which was in turn inspired by a report published by the Royal Academy of Engineering in the UK. It has also been influenced by evaluations recently conducted by other Swedish Universities (Uppsala and Lund).

The criteria for the scientific evaluation were:

- Scientific Quality
- Recognition and Leadership
- Relevance and Impact
- Strategy and Potential

Each criterion was evaluated on a scale of 1 to 6 (Appendix 2). The Scientific panels were asked to comment briefly on the profile of the entire research field at SLU and the relationships between the UoAs within it. Their evaluation focuses on the UoA. Although the score awarded to any UoA is naturally important, the comments and recommendations of the panels have greater long-term value.

Where relevant, the panels were also asked to assess the quality and relevance of Foma operations, using the same criteria as those used for assessment of research (Appendix 2).

Evaluation documents were made available to all panel members one month in advance. The Scientific panels visited SLU in Uppsala on 4 – 8 May 2009 to conduct a dialogue with UoAs, from which the panel could make assessments and recommendations to the UoAs, as well as to the Faculties and University management, about how that area of research could best be developed. Each UoA was allotted between 45 minutes and 2½ hours, depending on the size of the unit. The units gave a brief presentation and there was time for questions and discussion. During their visit, each panel was accompanied by a host from SLU, who assisted with practical matters, answered questions, or forwarded questions to the KoN Management Team.

At the end of the visit, each panel gave an oral summary report to University and Faculty representatives and the KoN Management Team. A written evaluation report, based on a template form (Supplement B 5), was submitted after the visit. Each UoA was invited to comment on factual errors in the draft report before it was finalised.

The KoN Management Team met the Chairpersons directly before and after the evaluation week. During the pre-evaluation meeting, the chairpersons received information about the process and were able to ask questions. The post-evaluation meeting was an informal discussion about the evaluation process and general observations made by the panels.

2.4 EVALUATION OF IMPACT AND UTILITY

2.4.1 A user perspective

The basic premise chosen for the evaluation was to view SLU from a user perspective, i.e. how SLU's stakeholders *perceive* the quality of SLU. The result is therefore *estimated* impact and utility, which expresses the degree of conformity between expectations and how they are met. This differs from evaluation of scientific quality, which was carried out by fellow professionals, i.e. in the form of a peer review using a tried and tested model.

The impact evaluation was conducted in two parts, comprising a series of in-depth interviews with selected stakeholders, and a subject-oriented evaluation made by five Stakeholder panels.

A preparatory workshop was held in September 2008, attended by some forty invited participants, representing a number of stakeholder categories (ministries, public authorities, trade and industry, funding agencies, NGOs and media). The discussion provided information on stakeholders' views of what, in principle, is of utility to them. This formed the basis for developing assessment criteria and principles for the forthcoming evaluation.

The form of the evaluation was based in part on a literature review, e.g., reports from the evaluations of research impact carried out by funding agencies (Formas 2007; FBA Holding AB 2008; Zeilon 2008). FBA Holding AB, an independent consulting company with experience of conducting evaluations of higher educational institutions, took an active part in the discussions on methodology.

2.4.2 Underlying principles

Themes

The concept of "Impact and Utility" in KoN is based on the definition by the Swedish National Agency for Higher Education (HSV) of the basic mission of universities in relation to the world around them (HSV 2004, HSV 2005). These themes are:

Democratic development

This involves dialogue/communication based on mutual trust with the surrounding community, particularly with the public and politicians by way of popular science publications, participation in seminars, public debates, etc. This enables people themselves to act, to take part in the democratic process and to contribute to the development of research. This means that confidence in the contribution made by research to favourable societal development must be created. This generates reasons for, and commitment to, continued funding by the government and other sources.

Knowledge development and growth

SLU belongs to a knowledge, innovation and commercialisation system for the purpose of starting up enterprises, applying ideas and results generated by research to services or products in the market and contributing material on which to base decisions. This is achieved by working with private enterprise and the public sector to develop results, methods and tools that can be used in those sectors.

Recruitment

The content of education programmes (basic, postgraduate and contract education) is expected to meet the demands of the labour market (student employability). For example, what are the employment prospects for graduates and what interaction with the outside world forms part of the education programmes?

Key words

Based on a survey of the literature and the experience of FBA Holding AB, ten keywords were identified describing the qualities considered to be most important from a stakeholder viewpoint (Table 3). These keywords constituted the framework for the in-depth interviews and were also used as a tool for analysing the results from the interviews and Stakeholder panels.

TABLE 3. *Key words used to describe stakeholders' views on Impact and Utility*

Key word	Characteristics
Expertise/skill	Knowledge, ability, reliability, reputation
Adaptability	Flexibility, needs-oriented
Independence	Autonomous, questioning, foresight
Innovativeness	A wealth of ideas, fresh thinking, originality
Capacity	Stability, continuity, critical mass
Interaction	Networks with the right leading partners, degree of interaction/co-production, joint funding
Value added	Dialogue, refining/packaging, delivery method
Utility	Relevance, adaptability
Impact	Application (product/service/organisational development, business utility, competitiveness, policy impact, other influences)
Openness/accessibility	Reception, availability, penetration potential

2.4.3 In-depth interviews

The in-depth interviews were conducted by FBA Holding AB. A total of 28 people representing various stakeholder categories were interviewed in April and May 2009. The results are summarised in the report "SLU ur ett intressentperspektiv" (Supplement R 3). The results from the in-depth interviews are one of the foundations of this report and were also used as a support for the Stakeholder panels.

2.4.4 Stakeholder panels

The subject-oriented evaluation was made by five Stakeholder panels having a total of 35 members. The composition of the panels was determined on the basis of the five most important product and service sectors in which SLU develops knowledge:

I. Food (agriculture and horticulture, domestic animals, aquaculture)

II. Animal Health and Welfare

III. Raw Materials for Energy and Industry (fibres, timber, energy, etc.)

IV. Spatial Planning, Environment and Nature (urban and rural areas, recreation, health and leisure)

V. Environmental Monitoring and Assessment (Foma)

Each panel had 5 – 8 Swedish (and in a few cases Nordic) members, representing SLU's key stakeholders (Appendix 4). Criteria for selection of panel members were knowledge and experience of SLU's operations, as well as a good overview, knowledge and understanding of the relationship between a university and its surrounding world. There was also a desire that someone on each panel could cover the international dimension. Panel composition was decided in close consultation with the faculties and was formally decided by the Vice-Chancellor.

The criteria chosen for the evaluation were:

1. Technical quality and relevance
2. Functional quality
3. SLU's image
4. Future challenges

The evaluation criteria are described more in detail in Appendix 5.

In addition to panel members' own experience of SLU, the panels based their assessments on reports by stakeholder representatives from the Scientific panels' assessment of Relevance and Impact, the results of the in-depth interviews, and self-assessments from centres with an outreach profile (Appendix 6). The Foma panel was provided with written self-assessments of ongoing Foma programmes (Appendix 6), as well as oral presentations of those programmes. The self-assessments and oral presentations were carried out by the coordinator for the respective programmes.

The panels met 23 – 25 June at Ultuna and Krusenberg, close to Uppsala. The meeting concluded with an oral presentation by each panel of analysis and conclusions for SLU management and the KoN Management Team. Each panel drafted a written evaluation report in line with a predetermined format (Supplement B 6). An SLU administrator acted as secretary during the report compilation phase.

2.5 COMPARISONS WITH EVALUATIONS AT OTHER SWEDISH UNIVERSITIES

The KoN evaluation at SLU was preceded by three Swedish, university-wide evaluations of research:

- Uppsala University (2007): Quality and Renewal 2007
- KTH (2008): Focusing on Quality. International Research Assessment Exercise 2008
- Lund University (2008): Research Quality Assurance for the Future, RQ08

The overriding aim of all four evaluations was to identify strong research areas, and to obtain essential information for strengthening quality. Uppsala University (UU) also stressed identification of emerging science and opportunities for renewal as a particular objective. For obvious reasons, KTH's evaluation placed a degree of emphasis on applied science. Lund University (LU) expressed more clearly than the others that the evaluation included identification of research areas and environments that were not competitive and lacked obvious development potential. Two major features distinguish SLU's evaluation from the others:

- In addition to research, KoN included Environmental Monitoring and Assessment (Foma), a field of operation unique to SLU among Swedish universities

- KoN has a stronger emphasis on the impact of research outside academia, and includes an extensive examination of stakeholders' views on the relevance of research, and on the impact and utility of research results (2.4)

The second feature is of particular importance when comparing KoN results with those of other evaluations.

Peer review

The Scientific evaluation in KoN was carried out in much the same way as the other three evaluations, i.e. using panels of highly qualified international experts, who based their assessment on documentation obtained from researchers, e.g., basic data and self-assessments. As with UU and KTH, the panels were given the opportunity to meet and interview all UoAs. However, in KoN these meetings were all held on "neutral ground", since it would have been logistically impossible for each panel to make proper site visits to SLU's campuses, which are distributed throughout Sweden.

Evaluation criteria

While "research quality" is naturally included in all research evaluations (although definitions and indicators differ somewhat), each university has applied a different set of criteria. The choice of criteria in KoN has been influenced by the other evaluations, and most criteria are shared, wholly or in part, with one or more of the others. Whereas UU and LU are universities in the classical sense, with a broad range of faculties, SLU, like KTH, is a sectoral university, with a more or less clearly defined "user market", i.e. research focuses on areas of importance for certain sectors in society. Thus, the criteria chosen for KoN display the greatest similarity with those used by KTH; although differently phrased and aggregated. The main difference compared with KTH is that KoN does not differentiate between "basic" and "fundamental" research; thus, assessments regarding the criteria Scientific Quality and Relevance and Impact were made irrespective of the nature of the research.

Structure

One major difference between KoN and the others is that assessments have been made at research team level. In general, the other three universities have used departments (or other large clusters) as the unit for evaluation, even though evaluators at UU, for example, were encouraged to identify individual research teams with a certain degree of prominence or potential. In particular, it should be noted that the "Unit of Assessment" concept used by SLU is not the same as that used by KTH. Thus, KoN results are more detailed, which may be an advantage; on the other hand, the fact that the UoAs in KoN are not organisational units linked to the administrative system may make implementation of results less straightforward.

Bibliometric analysis

Another major difference is the use of bibliometric data. While the other universities have chosen to carry out separate bibliometric analyses as a complement to the peer review process, bibliometric data in KoN were provided to the panels to simplify their work and also to achieve greater "standardisation" of the assessment of scientific publishing. The outcome of this approach is discussed in Chapter 3.4.

3 SCIENTIFIC EVALUATION - RESULTS AND ANALYSIS

3.1 GENERAL COMMENTS ON THE PEER REVIEW PROCESS

The evaluation made by the Scientific panels has provided SLU with a valuable foundation for decision-making at all levels at the University. The comments given in the reports (Supplement R 2) are informative and constructive and help to identify strengths and weaknesses and actions to be taken. The numerical scores awarded by the panels to all UoAs (Appendix 3) are a tool that can be used to obtain a broader picture. However, for a number of reasons, a degree of caution must be exercised when interpreting these scores.

Judging by their comments, the panels appear to have been strict (or generous) to varying degrees when grading the UoAs. The panels were instructed to assess performance in an international context, i.e. the objective was not to compare different units at SLU but to compare each UoA with international standards, i.e. with counterparts at other universities. Even though all panels have carried out their task in a careful and conscientious manner, peer review is not an exact science, and reviewers have differing backgrounds, experience and outlook. A further complication is that the majority of criteria were complex, and the panels chose to place emphasis on different aspects when grading the UoAs. Thus, numerical comparisons of individual UoAs assessed by different panels should only be made after careful consideration. Panels may have chosen somewhat different levels for awarding a certain score; a scrutiny of scores and verbal comments gives the impression that scores may vary by as much as +/-1 depending on the panel. Nonetheless, a 5 or a 6 must be regarded as strong, and less than 3 as very unsatisfactory.

The KoN Management Team tried to allow for variations in UoA size and in the number of UoAs assessed by each panel by adjusting the time allotted for interviews with UoAs and for the panels' own discussion. Even so, panels with fewer UoAs clearly had more time to go into greater detail/depth than did panels with many UoAs. Panels with many UoAs had a greater tendency to use the entire grading scale.

For all four evaluation criteria, statistical analysis revealed a significant positive effect of UoA size (number of staff) on the score (Kruskal-Wallis test). This effect may reflect a factual difference (i.e. larger UoAs perform better) or an unconscious bias (i.e. difficulty in appreciating performance in relation to team size). The performance of a UoA is naturally influenced by factors such as funding situation and teaching load. The operational data available did not allow calculation of the efficiency of the various UoAs.

To sum up, scores should be used with caution, taking verbal comments into consideration.

3.2 RESULTS AND ANALYSIS OF THE FOUR EVALUATION CRITERIA

3.2.1 Scientific Quality

This evaluation criterion covers aspects such as originality of ideas, choice of methods, scientific productivity, impact and prominence. The panels were asked to comment on the geographical

scope and quality of academic networks and collaboration. The impression is that this was the criterion that the panels were most comfortable with, since assessment of scientific quality is an established practice in the academic sphere and reasonably universal across disciplines.

As with the other criteria, the panels appear to have applied slightly different thresholds for the different scores. The panels were encouraged to use the entire scale of 1 to 6 (where justified), although only one panel did this. One panel (Economics and Statistics) expressed their hesitation in awarding the highest score (6) because they were uncertain of how the term "world leading" should be interpreted.

Outcome - SLU and Faculty levels

The average score for Scientific Quality for the entire university was 3.9. Nearly one-third (32%) of the UoAs were judged to be of at least "high international" standard, with 7% "world leading" (Fig. 1). The proportion of UoAs receiving a score of 4 ("internationally recognised") or higher was 66%. The panels found 12% of the UoAs to be below "moderate" standard, i.e. they were awarded scores lower than 3. Although there is considerable room for improvement, the overall outcome must be seen as satisfactory.

The average score for the four faculties ranged from 3.3 (Landscape Planning, Horticulture and Agricultural Science) to 4.2 (Natural Resources and Agricultural Science). However, due to the large variation, there were no statistically significant differences between the faculties (Kruskal-Wallis test).

Strong and weak research fields

For five research fields, the average score for Scientific Quality was well above 4, with the outstanding top score 5.5 for Plant Science (Table 4). The other fields were: Ecology and Environmental Sciences; Plant Protection; Chemistry, Molecular Biology and Microbiology; and Food Science and Safety. These research fields all represent biological research that in general has a strong emphasis on "fundamental" as well as "applied" approaches. Six of the nine UoAs judged as "world leading" belonged to these fields, and in all only three of 27 UoAs scored below 4.

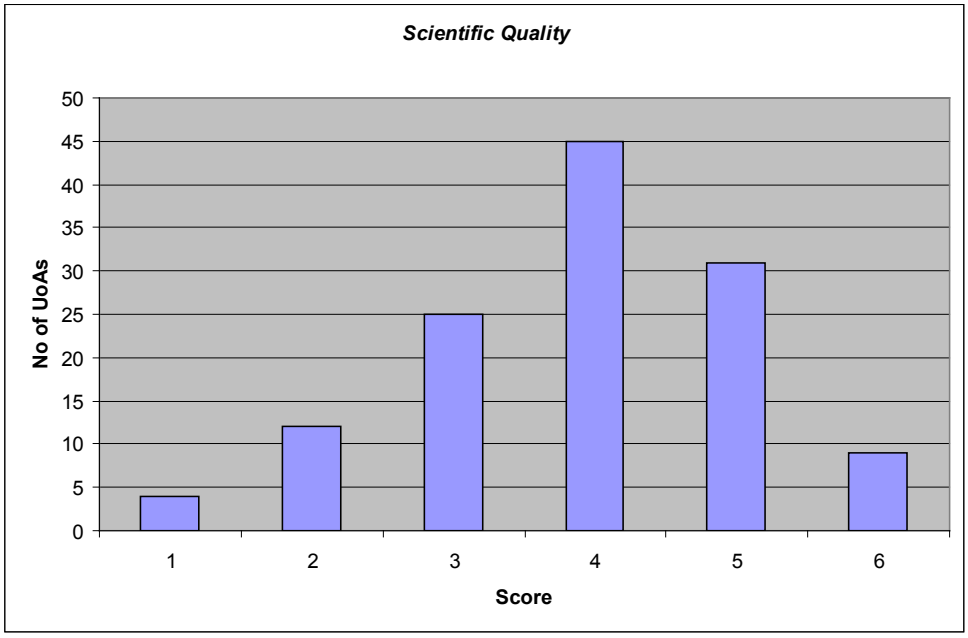

FIGURE 1. *Distribution of scores for the Scientific Quality criterion*

TABLE 4. *Overview of scores awarded by the Scientific panels. N refers to the number of UoAs assessed. For scores for individual UoAs, see Appendix 3.*

		N	Scientific Quality			Recognition and Leadership			Relevance and Impact			Strategy and Potential		
	Research Field		**mean**	**max**	**min**	**mean**	**max**	**min**	**mean**	**max**	**min**	**mean**	**max**	**min**
1	Economics and Statistics	12 [1]	3.5	5	1	3.7	5	2	4.5	6	2	3.3	6	1
2	Landscape Architecture, Urban and Rural Development	14	3.8	5	2	3.6	5	2	3.9	5	2	3.7	6	2
3	Ecology and Environmental Sciences	11 [1]	4.4	6	3	4.8	6	3	5.0	6	3	4.2	6	2
4	Food Science and Safety	3	4.3	5	4	3.7	4	3	3.0	3	3	3.3	4	3
5	Animal Health	12	3.9	5	1	4.0	6	2	3.9	5	2	3.2	5	1
6	Animal Husbandry	11	3.6	5	2	3.5	5	2	4.1	6	3	3.5	5	2
7	Biomedicine	5	3.8	5	3	3.6	4	3	4.4	5	3	3.2	4	2
8	Forest Management and Products	12	3.8	6	1	4.0	6	1	4.6	6	2	4.1	6	1
9	Biosystems Technology	9	3.6	5	2	3.6	6	3	4.0	5	3	3.8	5	3
10	Plant Protection	10	4.4	6	2	4.6	6	3	4.7	6	3	4.6	6	3
11	Plant Production	9	3.7	5	1	3.7	5	2	3.7	5	3	2.7	5	1
12	Soil and Aquatic Sciences	8	4.0	6	2	3.6	6	2	4.1	5	2	3.3	6	1
13	Plant Science	2	5.5	6	5	4.5	5	4	4.5	5	4	4.5	5	4
14	Genetics and Breeding	6	3.7	6	2	4.2	6	1	4.7	6	3	4.3	6	2
15	Chemistry, Molecular Biology and Microbiology	5	4.4	5	4	3.8	4	3	4.4	6	3	4.2	5	4

[1] The assessment of Scientific quality included 11 (Economics and Statistics) and 9 (Ecology and Environmental sciences) UoAs, respectively.

The Economics and Statistics research field achieved the lowest average score. Some research fields traditionally regarded as core subjects at an agricultural university, namely Biosystems Technology, Animal Husbandry, Plant Production and Genetics and Breeding, received low average scores. However, it should be stressed that there was wide variation within each field; several UoAs performing at a "high international" standard are found, and one UoA in Genetics and Breeding was given top score. Moreover, the low average score of Economics and Statistics may reflect the fact that this panel avoided awarding the highest score as a matter of principle (see above).

Although comparisons between research fields are somewhat unreliable (3.1), the scarcity of top-notch teams in fields such as Animal Husbandry and Plant Production is a problem that SLU must address if it is to become one of the leading agricultural universities.

Positive examples

UoAs awarded top scores – "world leading" – by the panels are characterised by a strong output of scientific publications, as witnessed by comments such as "*excellent, highly cited and recurrent publications in leading journals"*, and "*outstanding publication record, not just in terms of tier 1 journals in the field, but also in the highest impact general journals (Science, Nature, PNAS*)". An innovative approach and adaptation of new methodology were other important features: "*The researchers have adopted a multidisciplinary approach to carry out innovative research using modern research techniques and methods*". The ability to successfully combine curiosity-driven and needs-driven research was also appreciated: *"[the UoA] marvellously manages to implement demand-driven research into a scientifically conceptual framework*." A good educational environment and high output in terms of PhD graduates were also rewarded.

Reasons for low scores

Although the reasons for obtaining a low score on this evaluation criterion are specific in each case, some general patterns can be seen. A low score is most frequently associated with low productivity in terms of scientific publications (for which in turn there may be a range of individual reasons). This is evidenced by comments such as "*The number of scientific publications is relatively low and output unevenly distributed between researchers*" and "*The number of publications is good but could improve, given the number of researchers and their low teaching expectations.*" A low number of PhD degrees awarded during the period evaluated also lowered a score.

Some units with below average scores are encouraged to reconsider their publishing strategies. Typical comments are: "*Though the article production is high, the list of blind peer-reviewed articles is rather short*", and "*Scientific productivity is reasonable, but the quality of journals selected for publication could be improved with a better publication strategy*." The need for publishing in international journals is stressed in a few specific instances (Landscape Architecture, Urban and Rural Development panel). Interestingly, some panels commented on suboptimal publishing strategies even for UoAs with good scores, i.e. in their opinion the quality of research warrants publication in top rank journals, and UoAs are encouraged to submit their papers to better journals.

Subcritical mass and unfocused research activities, particularly in combination, are an obstacle to high scores in several cases: "*The small size of this research group, however, appears to be a limiting factor …*" Comments along the same lines were "*A clear prioritisation of niche research areas will greatly assist in developing high quality research…*", and *"…critical mass of academic staff and PhD students will be vital to gain the international profile that the work deserves*."

Several UoAs that did not receive high scores have undergone recent reorganisation or are still in the process of establishing themselves as a coherent research unit: "*They are clearly still in transition as a result of the new reorganisation, moving from a practice-based focus to more of a research-based and publication driven culture*."; and "*We recognise that this is an extremely new UoA and thus the UoA has not realised its full potential*."

Lack of innovative ideas and/or new technologies justify lower scores in some cases. "*Most of the research done is sound although not highly original…. The methods used do not always take advantage of the new molecular tools*." Even for some already strong UoAs, the panels expressed the need to adopt modern technologies, with access to facilities or platforms to improve standards and maintain international competitiveness (e.g., "omics" in Food Science, Animal Health, and Genetics and Breeding). Inter-faculty integration in the form of methodological collaboration and common platforms is suggested in subjects such as statistics, mathematical modelling and bioinformatics.

Extension, consultation, etc. versus research

In some cases, the panels had difficulty assessing scientific quality due to the unclear status of the unit. While a few UoAs are in fact centres created for a purpose other than performing research - and were found by the panels to be unassessable (3.2.3) - many more have difficulties managing the balance between a traditional role as an extension service and scientific approaches. Two quotes from the Animal Husbandry panel describing this problem are: "*The evaluation panel gained the strong impression that the UoA is playing a major role as adviser or extension centre rather than as a real research unit.*"; "*…there is concern that the scientific quality of the UoA is being diluted by work which no doubt has high value to the funders, but does not lead to scientific publications*." In veterinary medicine, maintaining the clinical competence needed for education, while at the same time conducting high class scientific research, can create a dilemma: "*The panel gained the impression of a hard working group of dedicated and creative clinicians, whose interests seem not to be primarily in the area of research*" (Animal Health panel). These quotes undoubtedly reflect SLU's identity as a sectoral university, where researchers face the challenge of striking a balance between scientific ambition and the wish to serve users.

3.2.2 Recognition and Leadership

Generally, the panels frequently commented that Recognition and Leadership identifies some of SLU's strengths as well as some of the major problems for scientific development. It is obvious that "Recognition" and "Leadership" do not always correlate as closely as the panels suggest, but mostly there seems to be good agreement – to be excellent at leadership also results in positive scientific recognition. Most panels evaluated "Recognition" both for the scientific community and for society and industry. "Leadership" was examined for the capacity to play a leading role in (mainly international) scientific development, as well as for the capacity to be a good academic team leader.

Outcome - SLU and Faculty levels

The average score for the entire University was 3.9, with a full range of 1 to 6. Nine units, representing 7 research fields, had the highest score of 6; two units had a score of 1, and 8 units, assessed by six panels, had a score of 2 (Fig. 2). There tend to be differences between Faculties, with a span of 3.6 (Landscape Planning, Horticulture and Agricultural Science) to 4.1 (Natural Resources and Agricultural Sciences). The Faculty of Forest Sciences showed the largest variation in amplitude, i.e. from 1 to 6.

Strong research fields

The research fields with the highest average scores (4.2 or above) were: Ecology and Environmental Sciences; Plant Protection; Plant Science; and Genetics and Breeding (Table 4). Most other fields had considerably lower scores (3.5 to 3.7).

Examples of positive comments from the panels:

> *"The senior scientists in the group are highly qualified and respected experts …. Their active guidance and supervision of younger scientists …, high motivation and enthusiasm for their work, as well as good infrastructure and valuable international contacts provide an attractive research environment for young scientists."*

> *"Collectively they probably comprise the highest concentration of plant scientists in the world."*

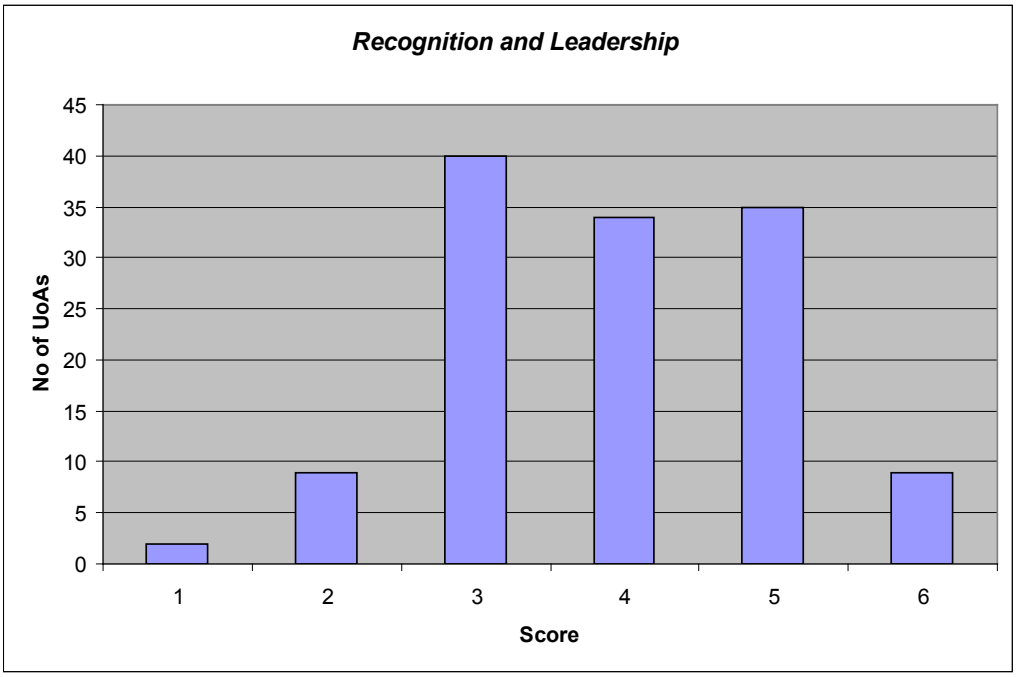

FIGURE 2. *Distribution of scores for the Recognition and Leadership criterion*

Aspects of Recognition and Leadership

One major aspect is the ability of a unit not only to take part, but also to play a leading role, in the national or international scientific debate in their sector. Other concepts here are high scientific integrity or visibility. This criterion also includes whether a unit can serve as a trusted source of opinion in society as well as in industry, for example, "*…evidenced by the frequent involvement of the unit in policy and decision-making processes*." Particular instances where information tools have been developed are appreciated, such as "*An interactive web site has been established and is successfully engaging Swedish citizens in dialogues on relevant "bio issues""*".

A typical positive appraisal: "*The UoA is well able to lead the scientific debate in their sector in offering a high degree of scientific integrity with practical solutions…*"; and negative ones: "*The panel has found that the UoA has shown low ability to lead the scientific debate so far*"; and "*.. there appears to be no or at best minimal likelihood of this UoA acting as an independent and trusted source of opinion for the general community*."

The international dimension is an important area for a positive evaluation in 'Recognition and Leadership'. This is certainly to some extent correlated to the success rate in the scientific debate, but is commented on separately by all panels. For example, the panels evaluated representation in international commissions, interaction with scientific societies, international co-authorship, links with leading international research teams, and number of visiting scientists, etc. It was said that SLU is generally well-recognised internationally; for example: "*The internationalisation approach demonstrates Swedish leadership in education and training of scientific leaders throughout the world*."

However, several research teams show a low international engagement, e.g., *"…too many faculty lack an international dimension*". In a few cases it was not considered a drawback for a unit to have restricted international recognition, provided research was of a high national standard and recognised nationally.

Organisational matters, staff problems and a lack of funding are some of the major obstacles to positive development. This applies particularly to unit size, as pointed out by all panels. One of the main obstacles to scientific recognition at SLU seems to be that structures are often too fragmented and that individual research teams do not achieve critical mass. A typical comment was: *"Larger research teams are required to develop internationally recognised centres of excellence in a particular field";* and: *"The group suffers from being too small, (since) there is no overall conceptual framework for integrating research ideas."* In a few cases the panels somewhat surprisingly considered a unit to be successful despite its small size, thanks to extensive external collaboration and an attractive research environment. A good research environment or a good "team spirit" in a unit or department has a very positive influence. In some cases it was noticed that competition between units at SLU was hampering scientific development: *"The panel felt that the numerous opportunities for collaboration … have all been viewed as threats or competition rather than opportunities."*

SLU has recently undergone various cycles of reorganisation at all levels, which in some cases has had a detrimental effect on scientific recognition. On the other hand, it was recognised by the panels that reorganisation and amalgamation of teams in some units have been highly successful: *"It has allowed for the cross fostering of ideas and expertise."*

Academic leadership is generally considered rather weak at SLU in many units, and this is sometimes due to individuals, who may have a strongly positive or negative influence: *"… scientific leadership by the most senior member of the group did not appear particularly effective";* or even stronger: *"The development of a strong, respected research group with a suitable critical mass for growth and innovation and interdisciplinary research (which has been a hallmark of SLU's success in the past) may be hindered by the intellectual and philosophical domination and attitude of one or two senior researchers…"* In at least one case, however, the lack of academic leadership has actually been a positive factor: *"… notably their research focus has developed from the grassroots – that is to say by the researchers themselves without research leadership from a full professor."*

Ideal leadership may consist of an optimal combination of basic and applied work, combined with teaching at all levels: "*The UoA is led by… who have a clear understanding and commitment to ensuring a synergistic balance between teaching (both undergraduate and post-graduate), clinical service and research*."

Several panels commented on interdisciplinary initiatives, particularly those designed to establish close links between the natural and social sciences and the humanities. Synergies and extensive collaboration are central to excellence in scientific recognition, not least interdisciplinary work and inter-university networking, on a national scale as well.

3.2.3 Relevance and Impact

The instructions to evaluators described Relevance as the ability and future potential for generating knowledge that will contribute to sustainable development of society, including industry. In assessing relevance, the panels were asked to focus on the problems addressed and the general approach chosen by the UoAs. Characteristic features of Impact were high value interaction with public authorities, companies and other partners outside academia (including citizens), successful entrepreneurial activities or consultancy.

The interpretation of the Relevance and Impact criterion differed between the panels, since some research fields concentrate more on basic research (e.g., Biomedicine; Chemistry, Molecular Biology and Microbiology), and others are more applied in nature (e.g., Biosystems Technology).

Outcome – SLU and Faculty levels

Relevance and Impact received the highest average SLU score of the four criteria, 4.2. 75% of the UoAs scored at least 4 ("high importance") and 43% scored at least 5 ("very high importance"). No UoA received the lowest score (Fig. 3).

The average scores for the Faculties varied from 3.9 (Faculty of Landscape Planning, Horticulture and Agricultural Science) to 4.5 (Faculty of Forest Sciences), but the differences were not statistically significant.

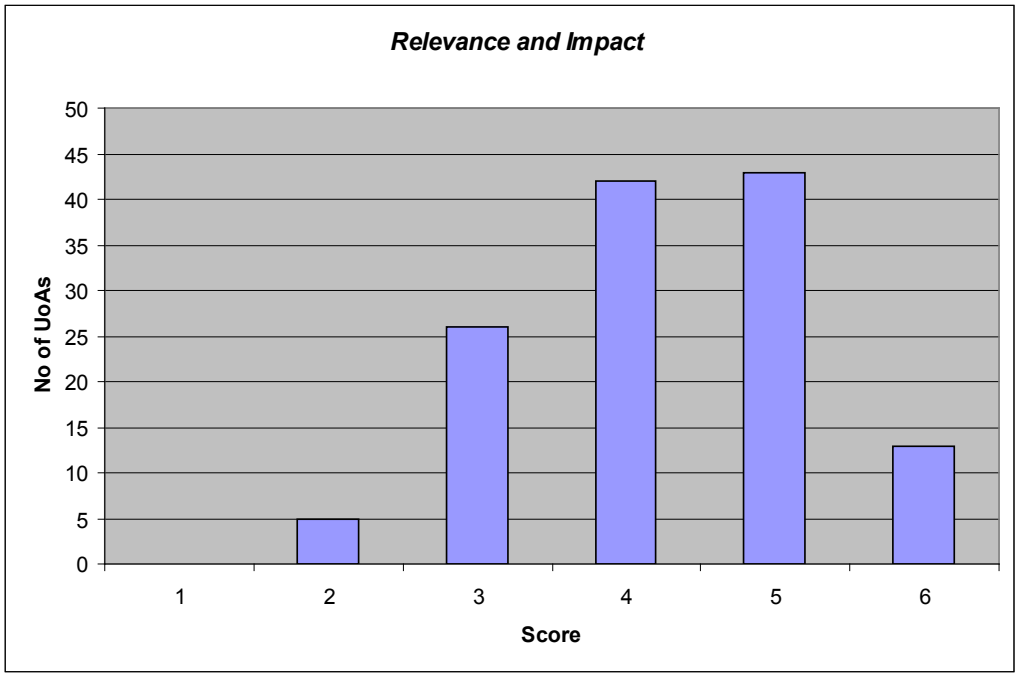

FIGURE 3. *Distribution of scores for the Relevance and Impact criterion*

Strong and weak research fields

Six research fields achieved an average score of 4.5 or above: Ecology and Environmental Sciences; Plant Protection; Genetics and Breeding; Forest Management and Products; Plant Science; and Economics and Statistics (Table 4). The research fields receiving the lowest scores were Food Science and Safety and Plant Production, areas that should be central for an agricultural university, although the average scores for these areas were 3 or above. Although scores are generally high, the panels urge many UoAs to develop their interaction with society further.

Information and interaction

The overall assessment is that research is of high relevance to society and many UoAs interact with society outside academia, e.g., public authorities, industry and the general public. The nature and depth of outreach activities vary from one-way information such as leaflets and web information, to in-depth interaction such as close research collaboration. Researchers act as experts in national and international agencies and organisations. There are good examples of networking used in communication with society: "*The UoA reports that they have an excellent network through former students to the industry. This is of high importance for developing new and relevant research ideas. These contacts also help to conduct empirical oriented research.*"

Strong relevance and impact

Units with high scores are very active in their interaction with society: e.g., extensive contact and communication with stakeholders, steering groups for research projects including industry

or stakeholder representatives.

The evaluation indicates that strong interaction with end users can be very fruitful for all concerned: *"…the UoA has been effective in developing "symbiotic" relationships with hunters and fishers, involving them in data collection and providing analytical expertise for interpreting the data"* and: *"The UoA recognises the mutual benefits in interacting with stakeholders; provision of insights into societal needs and knowledge of research methods and results, respectively."* One unit mainly conducts basic research that is curiosity driven, but that is nonetheless relevant to society: *"The researchers in this unit show that they are well aware of the potential applications of their basic research. The UoA filed several patents and started three companies. …. Basic research by the UoA will benefit from the activities at the companies, just as applied research at the companies benefits from the basic research by the UoA."*

Low relevance and impact

Many UoAs find it difficult to see themselves as responsible both for outreach activities and for basic research. In several cases the research was seen as highly relevant, but communication was lacking. Some units were not interested in interaction with society: "*It appears that the UoA mainly focussed on their own areas of interest and the science itself – not the outreach of the results… Therefore it is difficult to see that the research performed by the UoA has had any major impact on society up to now.*" Another reason is that a shortage of time and staff may mean that many small units find it difficult to conduct high quality research as well as outreach activities. However, it should be noted that some panels stressed that lack of time is no excuse for not communicating with stakeholders.

There are instances where the unit believes that their research has an impact, but the panels are of a different opinion: "*Most of the impact that was presented by the unit has in fact to be regarded as internal, and very little evidence of external impact was presented to the panel. The UoA valuated interaction with stakeholders as important, but this was not reflected in what the UoA actually has achieved so far.*"

The issue of what is communicated to society and the importance of high quality research in relation to relevance to, and impact on, society is expressed thus: "*…the UoA has close industry ties, actively participates in public debates……. The scientific output is moderate and therefore its relevance to society cannot be adequately assessed.*" Thus, a solid scientific base is central to relevance and impact on society.

The balance between research and outreach activities

This relationship was mentioned by several panels: "*Many research areas are clearly relevant and have considerable impact relative to stakeholder needs. The high level of applied research at an institution that also supports very basic research is a key feature of SLU.*" There were several examples of units that balanced this very well, but there were also examples of the opposite: "*Consideration must be given as to how to formulate the most effective teams that allow the more active research staff to focus on that business, with others helping with the remaining activities of the university, such as the production of practical farmer-oriented handbooks.*" However, other panels stressed that extension activities should not exclude the need to publish the results of applied research in scientific literature.

Non-research units

The three units that were not assessed for Scientific Quality (the National Inventory of Landscapes in Sweden, the Swedish Biodiversity Centre and the Swedish National Forest Inventory) all conduct activities relevant to society, and their impact on society is substantial or has great potential, according to the panels. The Forest Management and Products panel concluded that the Swedish National Forest Inventory «*primarily produces data and information – and not knowledge. However, in providing data and information, the unit is efficient and contributes to national policy formulation.*" The Ecology and Environmental Sciences panel suggests that the Swedish Biodiversity Centre could support other units in their communication with society.

3.2.4 Strategy and Potential

The panels were asked to comment on the future research potential of the UoAs and to identify areas of high and realisable potential in the UoA's strategic plan. They were also asked to comment on the UoA's resources for renewal, gender balance and to note whether younger faculty members are being mentored/recruited to support the UoA's strategic direction. They were specifically asked to comment on whether synergies between UoAs at SLU are being developed to their full potential.

Outcome – SLU and Faculty levels

The mean score for all SLU units for Strategy and Potential was 3.7, the lowest among the four KoN evaluation criteria. As many as 18% of all UoAs scored below 3 (Fig. 4). Mean scores for the faculties ranged from 3.6 (Landscape Planning, Horticulture and Agricultural Science) to 4.1 (Natural Resources and Agricultural Sciences), but the differences were not statistically significant.

Strong and weak research fields

Six research fields received mean scores above 4 (Table 4): Plant Protection; Plant Science; Genetics and Breeding; Chemistry, Molecular Biology and Microbiology; Ecology and Environmental Sciences; and Forest Managements and Products. The comparatively low scores for Economics and Statistics, Animal Health, Biomedicine, and Soil and Aquatic Sciences give some cause for concern. In addition, the nine UoAs assessed by the Plant Production panel received the very low mean score of 2.7 (range 1 – 5).

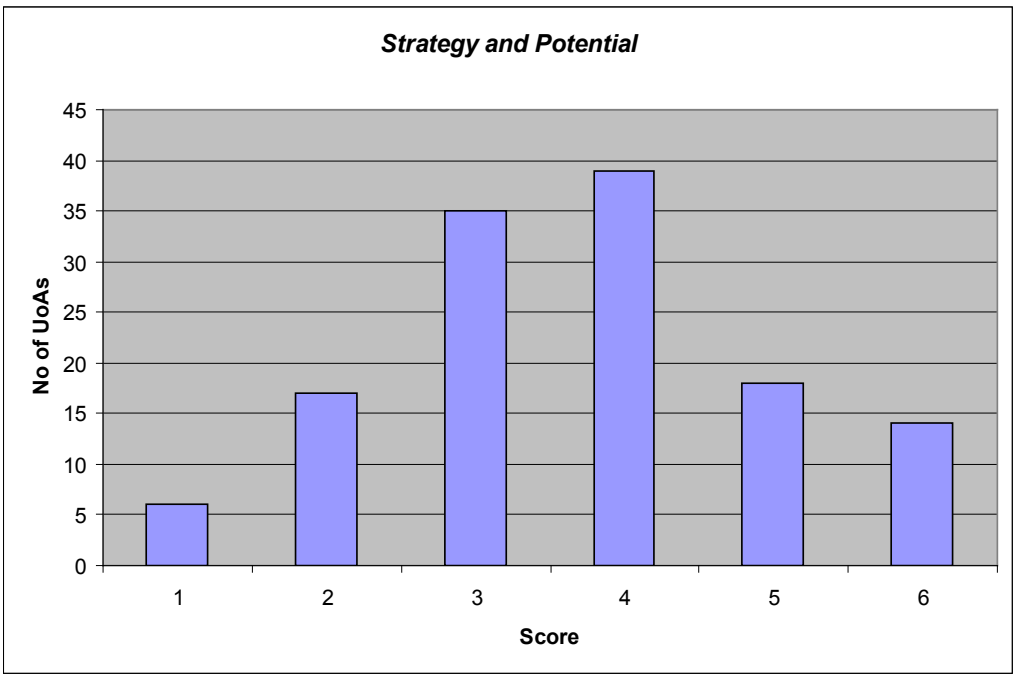

FIGURE 4. *Distribution of scores for the Strategy and Potential criterion*

Positive examples

Research units with long-term potential for success are characterised by good leadership, a clear and shared vision and an ambitious strategy with realistic objectives. Their potential is also dependent on the ability to fund a critical mass of scientists, the size of which may vary from one research field to another, with expertise and enthusiasm/commitment and access to adequate infrastructure.

Representative quotations from assessment reports on high scoring UoAs:

- *"A clear vision and strategy for the unit was communicated. There is explicit attention given to the human capital… This creates a positive environment, fostering creative thinking and stimulating unit interaction."*
- *"A focused research direction for the unit was expressed that was ambitious, yet appeared to be achievable. The PIs have a vision and are able to attract research funds."*
- *"The unit has a convincing strategy and the qualifications to reach the set goals. The unit has good collaboration with stakeholders and fine international relationships."*
- *"This research team should be held up by SLU as a model for how basic research can underpin and lead to success and progress in applied science."*

Negative examples

A characteristic shortcoming of units achieving low scores (1 – 3) for the Strategy and Potential criterion was the lack of a well-formulated strategic plan with significant visions and clear scientific objectives, and a lack of leadership. Failure to promote interdisciplinary research, overlap of research expertise between UoAs in the same Department, and a general lack of collaboration and interaction were also associated with low scores. Other factors were small unit size, and lack of replacement strategies as senior researchers approached retirement.

Representative quotations from the assessment reports on low score UoAs:

- *"This UoA does not have a viable strategic plan. Their major goal is to become larger, but they are not specific about how they will attain that goal."*
- *"The group lacks strategic vision and leadership and would benefit from improved strategic support from the Faculty… However, the lack of staff motivation and limited capacity reduce the realisation of the potential in the short term."*
- *"…, the unit faces the imminent loss of its two professors to retirement and unless accomodated, this will have a significant impact on the quality of the unit's research."*

Reasons for low scores

The comparatively low mean score for the Strategy and Potential criterion gives cause for concern. If the academic leadership at different SLU levels is not capable of providing viable strategies, guiding their respective units on future research directions, this will result in reduced scientific quality, as well as diminished relevance and impact. There may be many reasons for low scores, such as the fact that the UoA had been recently created, or even put together specifically for the evaluation, in the latter case not being a natural research unit. It should also be noted that long-term research strategies, including decisions on internal funding, are generally formed at departmental rather than UoA level.

In many UoAs, the leading professor is approaching retirement age and no active replacement strategy has been decided by the Faculty. The particular Swedish funding situation is another factor reducing the ability to formulate long-term strategies. For many scientists, funding is typically in the form of small, short-term grants from a number of sources.

At almost all universities, only scientists with a permanent position as senior lecturer (*lektor*) can apply for professorial appointments. Some years ago, SLU decided that all senior scientists would be allowed to apply for promotion to professor. This means that a very large number of qualified

academics funded by soft money have been promoted to professors at SLU. There is limited internal funding for these people, even though the "tenure track system" is designed to provide 20% of salary, or 50% at most. In practice, this means that SLU has created a large group of "proletariat professors" (the term used by the panels), whose funding status is highly unstable.

Low scores for the Strategy and Potential criterion might also reflect the fact that the actual potential for research is low due to changes/movements in scientific fields, i.e. a specific topic is obsolete, or in the case of applied research, that industrial/societal conditions have changed, leaving researchers behind.

The main reason for the strategy shortcomings of units appears to be that their scientists are not at all used to thinking in terms of strategic long-term planning. For some researchers, the self-assessment part of KoN may be the first time they have ever tried to formulate long-term plans.

3.3 GENERAL OBSERVATIONS

3.3.1 Leadership and strategic thinking

Strategic thinking is very closely related to leadership and these two concepts are here discussed together. Generally, strong concerns regarding leadership and strategic thinking were raised for all research fields and for the majority of UoAs. The panels identified a lack of strategic planning and thinking at all university levels, from unit and departmental level to Faculty and University management. To a certain extent, this criticism may have resulted from the UoA structure employed in the evaluation, which made it hard for the panels to gain a true picture of the decision-making structure at SLU.

Although the Strategy and Potential and Recognition and Leadership criteria received the lowest scores overall, there are good examples of units whose leaders have the ability to make a strong strategic plan together with their units: "*…the unit presented one of the few research strategies with a clear theoretical foundation for the empirical research they were undertaking and proposed to undertake.*" Another good example is: "*A clear vision and strategy for the unit was communicated. This strategy is to continue to be a world class unit… There is explicit attention given to the human capital ….. This creates a positive environment, fostering creative thinking and stimulating unit interaction.*"

However, according to the panels, many units failed in their strategic planning. Typical comments are: "*The goals and strategy put forth by this UoA are too general and appear to be only a compilation of individual projects*" and "*A confusing situation in the unit reflects a lack of strategic planning and leadership.*"

The many small units, overlaps and weak collaboration between units were seen as a sign of weakness in overall strategic planning. The limited collaboration "…. *suggests a lack of proactive directed management by senior faculty and departmental administrators; a strategic overview appears to be lacking, and in many cases organisational structure appears to be the result of history, choice and chance.*" Another example is: *"There also appears to be a serious failure within SLU senior management and the department to promote interdisciplinary research, including no clear articulation of the roles and scope of both basic discovery and applied research and the strategic direction at faculty/department levels and SLU collectively."*

Due to a perceived weakness in strategic thinking at the higher levels of university management, it was suggested that the University should create a "think tank" comprising senior faculty members, to support the Vice-Chancellor and University Board by providing analyses and future perspectives. It was also suggested that the University should train senior faculty members in strategic thinking, starting with the University's Senior Management Team.

3.3.2 Synergies and collaboration

Many of the panels have identified a clear need to develop a strategy for coordination and co-operation between units. Units have overlaps of activities of which they are sometimes, but not always, aware: "*The overall appearance shows considerable overlap and some duplication of research. There is a role for more coordination and a proactive attitude by the university to help develop collaboration that can bring about synergies.*" The small size of many units was commented on by several panels. They suggested a reorganisation of small units around conceptual content to reduce communication barriers, strengthen individual units and reduce overlap. Several panels also expressed surprise over the funding model, which underpins competition between units instead of cooperation. "*The nature of the funding model appeared to generate excessive competition between research groups within SLU working on similar problems; this could be seen as inefficient and counter to potential benefits for collaboration.*" One panel expressed surprise that SLU still operates using relatively small departments, when many universities have chosen to merge specialist groups into larger units, which facilitates interaction, exchange, management and use of core facilities.

Several panels considered there to be many potential synergies and multidisciplinary/ interdisciplinary activities between the disciplines, e.g., "*SLU-funded Strategic Programmes involving different groups would greatly facilitate transdisciplinary and transdepartmental collaboration.*"

Research in several fields is performed at different faculties and different places. The distance between campuses and the administrative divisions hinders networking, cooperation, and communication. However, this is not always so: "*Interestingly, the UoA was questioned whether it would benefit by moving to Uppsala. They rejected this idea, rightly stating that the interactions they currently have with Uppsala … are probably better than many of the Uppsala-bound UoAs have between each other.*"

3.3.3 Age structure, strategic recruitment and gender

Many senior researchers and professors at SLU will be retiring over the next few years. Several panels raise the issue of age structure and strategic recruitment, and there is a fear that these issues are not being sufficiently taken into account: "*In many cases members of the UoAs were uncertain whether existing staff close to retirement were to be replaced and if so, when. Hence, succession planning appeared to be poorly thought through.*" The large number of retirements may result in a loss of excellent research environments if the UoA and University do not plan for succession: "*Two senior professors in this UoA are recognised international leaders. Continuation of this excellent position will require succession planning, and younger members of this UoA need to be groomed to be able and ready to fulfil this leadership role*"; and "*The UoA is in transition, with a senior scientist close to retirement. The challenge will be to maintain the recent levels of achievement in a creative manner.*" In some cases it has been difficult to find a competent candidate for a position. Sometimes the process has started too late, creating a gap. The panels encourage the University to quickly fill the position. "*The age structure amongst senior staff appears very unbalanced; many people are close to retirement. The impression is that many SLU UoAs urgently need new highly qualified staff, with new ideas and cutting edge skills; in many cases, appointments from outside SLU would be of value.*"

Uncertain funding and a heavy teaching load were mentioned by panels as factors hindering recruitment of excellence. Also mentioned was the issue of teaching skill requirements versus scientific quality: "*...the recruitment of academic staff often appeared to be based on the teaching qualification of an individual candidate for a needed discipline or subject, and less strictly based on his/her research history.*"

There are also good examples of strategic recruitment and support: "*They have a clear plan for the recruitment and mentoring of junior faculty members.*"

Many UoAs pointed out the need for new positions and there are many such suggestions in the panel reports. Other panels suggest a reorientation or new focus following retirements, such as: "*Most of the researchers are approaching the end of their career (over 60). This presents an opportunity*

to direct the unit into strategic niche research areas." However, new positions were not always recommended: "*Typical of these (and typical of the general lack of interaction we have seen between most UoAs) is the strategic aim of recruiting a full-time professor…*" Instead, the panel suggests cooperation with another unit possessing the required expertise.

Mentorship to support younger faculty members is suggested: "*There is a need for a formal mentoring system and assessment of early career staff to enable them to attain their full potential. Improving job security and managing career progression of junior staff should help progression and retention, which is also vital for ensuring gender balance.*" One unit presented a clear strategy for career advancement for younger researchers: "*…this UoA provides some basic funding for all researchers, an important strategic measure, that we strongly support. There is also a clearly stated strategy for career advancement to "docent"* ["reader/associate professor"] *level.*"

Several panels commented on the uneven gender balance in many units. Although it varies, men usually predominate at higher positions, whereas there is a more even – or reversed - gender balance among PhD students. This situation is not unique to SLU. The senior research posts at most Swedish universities are predominantly held by men. Several panels expressed their concern at the skewed gender balance, and emphasised the need to be aware of gender issues. However, there were few suggestions of ways of changing the situation. One panel wrote: *"We could not elucidate causes for this serious imbalance, but we hypothesise that it is due to the funding instability for faculty"*, and continued: "*Recruitment should be based on excellence and not gender, but there are excellent women out there.*"

3.3.4 International links

Almost all Scientific panels stressed the need for SLU units to establish or strengthen their international links. Units with a purely regional or national scope would benefit from collaboration within the EU, or with other Nordic countries. Units – even several very prominent ones – that already have established European networks, were encouraged to seek wider geographical collaboration. This would strengthen the units' research agendas, give access to method development, and improve the visibility and impact of the research, i.e. promote research quality in general. For some units, increased international links would serve to alleviate recruitment problems by attracting graduates and PhD students. Stronger international links are also suggested by several panels as a means of broadening the funding base for some units, the main recommendation being to apply for funding within the EU framework.

The means suggested for strengthening international links include international training of PhD students: "*…could yield highly positive results and increased international contacts*." UoAs could encourage PhD students and post-docs to spend time working in overseas research teams, as expressed: "*We recommend finding ways to send students and post-docs abroad, [and to] give mid-career sabbaticals*". A system for recruiting more visitors from abroad was also recommended.

At least 25% of the UoAs at SLU are currently engaged in activities in partnership with developing countries (mainly within Landscape Architecture, Urban and Rural Development, Animal Husbandry, Forest Management and Products, Plant Protection, and Soil and Aquatic Sciences). These activities include research collaboration, but also teaching. Many UoAs are commended for this work, which also serves to increase the visibility of SLU and to attract PhD students. Scientific knowledge generated across SLU is often of global utility, e.g., infectious disease management, modelling effects of climate change and basic understanding of ecosystem processes. The Forest Management and Products panel commented that although several research teams are already working successfully with developing countries in Asia, Africa and Latin America, there is still potential for expansion.

However, some panels found UoA research activities in developing countries to be too scattered, and recommended coordination by the University. "*There is a need for coordination of interna-*

tional activities if this is to become a growth area at SLU". Doubt was also expressed as to whether a small research team is really capable of having research activities so far apart geographically (e.g., in Sweden and the Far East) without adversely affecting the efficiency of the research process.

UoAs should coordinate their work with other research teams at SLU and abroad in order to draft project proposals with a broader scope, covering longer periods. This approach opens the way for using the combined expertise of different research teams, including economic and social aspects of development. In this way projects will have better prospects of attracting funding from important donors, and contributing to substantial improvements.

3.4 BIBLIOMETRIC ANALYSIS

SLU chose to conduct a bibliometric analysis in advance of the peer review in order to provide assessors with ready data. The Scientific panels were provided with publication lists, bibliometric analyses for each unit and summarised bibliometric data for each panel (2.3).

3.4.1 Results and analysis

The present report focuses on five selected bibliometric indicators (Table 5). Detailed bibliometric reports, including 10 indicators summarised for each of the 15 research fields, are given in the Supplement (R 1), together with full background information on the principles used in the analysis (Supplement B 2).

SLU level

Overall, SLU has internationally competitive scores for the chosen indicators. For example, the overall SLU score of 1.28 for NCSf (Field Normalised Citation Score), lies well above the world average (1.00). Comparisons with individual universities are generally complicated by the use of differing methodology. However, the recent evaluation by KTH (2008) also used the "brain power" approach, resulting in comparable overall university scores for CPP: 7.0 (12.0 SLU); NCSf: 1.31 (1.28 SLU); Top 5: 7.5% (12.7% SLU). NJCS: 1.16 (1.14 SLU)

Research Fields

Many research fields perform exceedingly well, for example on the Top5 indicator, where 14 of 15 fields have higher values than expected, and 8 fields have a value twice as high (or more) relative to expectations. Ranking of the research fields according to bibliometric indicators (Table 5) yields a somewhat different picture than ranking according to the panel assessments. For example, Soil and Aquatic Sciences and Animal Husbandry rank significantly higher in bibliometrics than in the peer review assessment of Scientific Quality (SQ), whereas Plant Protection and Genetics and Breeding rank lower.

It is often argued that social sciences and humanities (i.e. the Economics and Statistics, and Landscape Architecture, Urban and Rural Development research fields) are shown in an unfavourable light by bibliometrics due to differences in publication cultures as compared with natural sciences. However, the use of field normalised indicators in Table 5 takes these differences into account.

TABLE 5. *Number of publications (1998-2008) and average scores for key bibliometric indicators for the 15 research fields. Fields are ranked according to NJCS scores and compared to the average scores for scientific quality (SQ) given by the Scientific panels.*

Research field	**P**	**CPP**	**NCSf**	**Top5**	**NJCS**	**SQ**
Plant Science	599	27.4	1.89	23.8	1.65	5.5
Ecology and Environmental Sciences	1192	13.7	1.42	15.8	1.23	4.4
Soil and Aquatic Sciences	1047	12.5	1.48	16.9	1.20	4.0
Food Science and Safety	612	10.7	1.45	15.5	1.19	4.3
Chemistry, Molecular Biology and Microbiology	799	12.2	1.10	9.1	1.14	4.4
Animal Husbandry	878	7.7	1.34	13.4	1.14	3.6
Forest Management and Products	726	11.8	1.42	14.0	1.14	3.8
Plant Protection	994	10.6	1.34	13.3	1.11	4.4
Animal Health	1567	8.4	1.32	11.5	1.09	3.9
Biosystems Technology	345	5.6	0.87	5.4	1.04	3.6
Biomedicine	655	12.4	1.09	9.5	1.04	3.8
Economics and Statistics	271	3.9	0.64	5.4	1.00	3.5
Genetics and Breeding	743	12.2	0.98	8.3	0.96	3.7
Landscape Architecture, Urban and Rural Development	178	5.5	0.89	3.9	0.94	3.8
Plant Production	392	8.1	0.99	8.1	0.94	3.7
Mean score		**11.2**	**1.28**	**12.7**	**1.14**	**4.0**

INDICATOR		*DESCRIPTION*
P	Number of papers	Number of papers (articles, letters, proceedings papers, reviews) published by the Research field during 1998 – 2008.
CPP	Citations Per Paper	Average number of Citations Per Paper (as of December 31, 2008) calculated without first author self-citations.
NCSf	Field Normalised Citation Score	CPP normalised in relation to mean citation rate of the Research field sub-field set (average = 1.00).
Top 5	TOP 5%	Percentage of papers that have received more citations than the 95th citation percentile within their sub-field.
NJCS	Normalised Journal Citation Score	Impact of the journal set in relation to its respective sub-fields (average = 1.00).
SQ	Scientific Quality	Scores awarded by the Scientific panels on a scale of 1 (poor) to 6 (world leading) standard

Discrepancies between scoring by the panels and bibliometric indicators are not surprising. While bibliometrics measures the quality of scientific (ISI-registered) publications, peer review of scientific quality also takes other factors into account, e.g., other publications, originality of ideas, choice of methods, and quality of academic networks and collaboration. The bibliometric indicators are calculated on all data for the assessment period (1998 – 2008) and thus, in contrast to panel assessment, do not take progress over time into account. In addition, differences may be partly explained by flaws in the bibliometrics arising because citations can be very unevenly distributed between articles, particularly in "high-profile fields" (genetics, molecular biology). It should also be noted that bibliometric comparisons between UoAs will not produce statistically

significant results unless the units have produced at least 30 publications in journals covered by the Web of Science. Forty of the 130 UoAs studied in KoN had less than 30 such publications.

3.4.2 Use of bibliometrics and publication data in the peer review

As expected, the evaluators took a keen interest in publication quality (3.2.1). The panels were very pleased to receive the bibliometric analyses in advance. Unfortunately, a post-evaluation survey revealed that the majority of panels did not find the bibliometric analysis useful in their task of assessing the UoAs. Some panels said they found the bibliometric analyses confusing, and in a few cases analysis results as such were questioned. However, several panels did use the bibliometric data as a factor in their assessment of Scientific Quality, and commented on the data in their report, e.g., "*All UoAs within this field have a scientific quality that is above the SLU average. This is evident from the bibliometric analysis, which shows most or even all of the indicators as being above average. About 10% of the publications reach a level that scores among the top 5%.*"

There may be several reasons why the panels did not make full use of the bibliometric analysis; however, the main reason appears to be that the UoAs often regarded the underlying publication data as incomplete or incorrect, and stressed this in the interviews. The use of a UoA concept (research team) that did not correspond to the organisational structure used in central databases made it very difficult to assemble correct staff lists, and hence, correct publication lists. Despite joint correction efforts by the researchers, as well as the KoN Management Team, the University Administration and SLU Libraries, a shortage of time prevented sufficient quality assurance of data. The data on ISI publications used in the bibliometric analysis, which were a subset of the data used for the publication lists, were probably less affected by quality problems.

In addition, the errors perceived in the publication lists may be largely due to the use of the "brain power" concept, i.e. only publications by staff employed on 31 December 2008 were kept in the centralised data sets. Both panels and UoAs found it hard to accept that publications by researchers that had recently left were not included. In retrospect, the bibliometrics specialists, as well as the KoN Management Team, failed to explain the logic of "brain power" to UoAs and panels. This shortcoming, combined with incorrect publications lists, created a general mistrust of the publication data in KoN. Confidence in the bibliometric analysis suffered as a result.

3.4.3 Bibliometrics as indicators

A number of indicators of research performance are used as tools for evaluation. Most of them are in some way based on peer review. External funding, particularly from research councils and similar agencies, is based on peer review, with an additional political bias due to current resource allocation to different scientific fields. Indirectly, bibliometrics is also based on peer review, either performed by the journal when accepting a paper, or as a consequence of researchers citing/not citing published papers.

Some panels stressed that bibliometrics does not provide the whole picture, particularly in some research areas. A quote from the Plant Protection panel: "*Any agricultural university anywhere in the world must ask itself whether imposing a single standard for scientific excellence based on citation counts and H-factors is an effective way to create a big tent that welcomes all types of agricultural researchers. Perhaps the goal of SLU to value a university-wide level of excellence, created by a balance of high-performing UoAs in basic science and by others in performing excellently in delivering useful knowledge and techniques, can be achieved by not over-emphasising numbers produced by bibliometrics.*"

Bibliometric analysis can be an efficient method of continuously monitoring publication activity and quality, particularly at a high aggregation level, e.g., Faculty or University. Thus, bibliometrics and peer review may both be regarded as valuable and complementary tools. The "brain power" approach to data selection may be useful in forecasting the potential for future development of research quality. However, its suitability for use in peer review evaluations such as KoN, which tend to focus on past performance, may be questioned.

4 EVALUATION OF IMPACT AND UTILITY – RESULTS AND ANALYSIS

The following analysis presents the collected results from the in-depth interviews of stakeholders, and four of the stakeholder panel reports (Food; Animal Health and Welfare; Raw Materials for Energy and Industry; and Spatial Planning, Environment and Nature). The results from the Foma panel are presented separately, together with the scientific assessments of Foma, since they solely concern Foma's specific situation and conditions (Chapter 5). However, many of the comments made by the Foma panel are in line with those expressed by other stakeholders.

Two FBA reports: "*SLU ur ett intressentperspektiv*", which presents the results of the in-depth interviews (Supplement R 3; FBA Holding 2009a) and "*SLU – Utvärdering av intressentnytta* " (FBA Holding 2009b), which presents a comparison between the in-depth interviews and the evaluation made by the Stakeholder panels, have provided important background material. The full reports from the five panels are given in the Supplement (R 4).

4.1 GENERAL OBSERVATIONS

The results of the evaluation of Impact and Utility reflect the quality perceived by stakeholders, i.e. how stakeholders perceive SLU. One of the Stakeholder panels expressed it thus: *"Naturally, the panel members' collective knowledge of SLU's operations in the field is in no way complete. Our comments reflect the current level of knowledge [of SLU's operations] of a group of key stakeholders."* The panel *"…finds, somewhat ironically, that this group, too, which has been selected on the basis of its relatively active and conscious relationship with SLU, has relatively little knowledge of current areas in which SLU is actually conducting research… It is therefore essential to develop communication on research issues and findings, whether the basic cause lies with researchers or us ignorant "practitioners"."*

The stakeholders were highly committed and favourably disposed towards SLU, and put forward a large number of requests and proposed measures to increase the mutual benefit. There is a high level of confidence, a feeling among stakeholders that SLU is engaged in matters of importance, that the University has a good reputation and quality-assured, excellent research, that it has networks, and a willingness to cooperate. Some (but not enough) researchers are well known and the issues addressed by SLU occupy a credible position in public debate.

4.2 SWOT ANALYSIS

4.2.1 Opportunities and threats

Opportunities

The stakeholders specified a number of opportunities for SLU to develop its operations and widen its network, thereby increasing the impact and utility of its research.

Increasing interest in society at large and more firmly held opinions in several of SLU's core areas (environment, climate, food, animals and energy) offer scope for SLU to be at the forefront

of developments, with a clearer role to play. A considerable number of stakeholders do not think that SLU has a sufficiently high-profile presence in society. If SLU takes a more active part in the social debate and in educating the public, this will bring research more into the public eye and lend it greater legitimacy, simultaneously raising the profile of the University.

The fact that stakeholders emphasise the need for more research in the fields for which SLU is responsible bodes well. A more systemic and holistic approach at SLU would open the way for expansion into new fields of research. It will render the University more attractive to actors in specific sectors, as well as the rest of society and produce better material for decision making. There are opportunities for SLU to address current societal issues in which the green sectors can contribute to solutions.

In the stakeholders' opinion, there are many potential partners that SLU has not yet "discovered". If SLU communicates its capacity and willingness to offer know-how and expertise in non-traditional areas, new stakeholders will become aware of SLU's potential. There are obviously more funding channels available than those SLU currently uses, e.g., under the EU system, which may offer potential for developing new research areas and offering further impact and utility.

Threats

SLU is no longer alone in producing the type of knowledge regarded as its core activity. Increased competition for research funding from other higher education institutions at home and abroad is a pronounced threat on which SLU must adopt a stance. A "brain drain" from SLU to other research organisations is also put forward as a threat. SLU's "invisibility" and lack of focus are seen as posing a risk of a decline in funding allocation. Stakeholders regard increasingly short-sighted funding as a threat that may reduce the proportion of basic research being conducted.

There is a risk in the lack of continuity in SLU's expertise and know-how in individual subject areas: "*Many projects and activities that have had an impact are heavily dependent on individuals, and are therefore vulnerable to changes and staff turnover.*" On the other hand, generation changes that are delayed or do not happen at all are seen as an obstacle to developing impact and utility.

Education forms an important part of knowledge transfer to the green sectors, and is thus a key prerequisite for impact and utility. Stakeholders consider that SLU education programmes are of a high standard, but that this has not been successfully communicated to the outside world. This poses the risk of a declining interest among prospective students. Failure to improve SLU's image is seen as a serious threat.

4.2.2 Strength and weaknesses

The analysis of SLU's perceived strengths and weaknesses is made on the basis of three themes, and ten key words that define and characterise Impact and Utility. A description of the themes and key words is given in Chapter 2.4.2

Fig. 5 shows the structure of stakeholders' comments on the basis of how they perceive SLU's strengths and weaknesses. The comments have been structured in terms of how they relate to Technical quality and relevance, i.e. content and orientation of SLU's research ("what"?) or whether they focus on Functional quality, i.e. SLU's working methods and approach ("how?") (Grönroos 1992; Vedung 1998).

	Weak ⟷ Strong	
What? **(Right thing)**	Democracy/society Innovation Commercialisation Impact	Expertise/skill Knowledge development Utility Recruitment base
How? **(Right way)**	Value added Interaction Adaptability Capacity	Independence Openness/accessibility

FIGURE 5. *Strengths and weaknesses. The structure of stakeholders' comments on the basis of how they perceive SLU's internal strength and weaknesses. Lateral placement indicates the degree of strength or weakness. For example," value added" is seen as a typical weakness, and "utility" is not as strong as "recruitment base".*

Strengths

Strengths express the impact and utility the stakeholders consider that SLU creates, which can be summarised for the technical and functional quality criteria:

Technical quality

The assessment relates to what has been delivered, i.e. whether SLU has conducted research on the right things from a utility viewpoint. To what extent has knowledge been relevant and generated results for the stakeholders? What products, services, functions and material for decision-making have been generated?

The responses can be summarised:

- SLU is perceived to offer *knowledge development at a high level*.
- SLU represents an *important recruitment base* for stakeholders. People in knowledge-intensive industries who ascribed importance to SLU education programmes are very satisfied. Those in more practically orientated sectors would like to see more practical applications.
- *The level of utility of knowledge delivered is considered to be high* but with a potential for revitalised contacts and networks. Joint projects between individual sectors and research teams work very well. Research findings have generally been well packaged when stakeholders have been involved in formulating research projects right from the outset.

Functional quality

The assessment relates to how knowledge has been developed, packaged and communicated. How has it been differentiated and adapted to meet the needs of the respective stakeholders, i.e. utility in context? Are external inputs put to good use? The environment in which research meets the rest of society, i.e. the information, communication/dialogue, is important. What arenas, networks, meeting places, communication tools are used?

The responses can be summarised thus:

- SLU is regarded as *independent, with a high level of integrity* (objective, reliable), in its supply of material for decision making and policy development, for example. Public authorities in particular adhere to this view.
- Contact with SLU is characterised by a good dialogue, in which SLU researchers are perceived to be *helpful and accommodating*. However, there is a very widely held view that SLU is "tacitly open", i.e. that openness and availability presuppose that the stakeholder itself initiate contact. A very serious problem for the sector is that there is sometimes a lack of knowledge about SLU's areas of know-how and expertise, where resource persons can be found, or whether they exist.

Weaknesses

A common feature of the weaknesses is that they are largely about SLU's ability to create *enhanced* utility: more types of utility for existing stakeholders and an untapped potential utility for players other than those currently closely affiliated to SLU. Put somewhat simply, it might be said that almost all weaknesses concern SLU's ability to come up with fresh ideas and communication/proactive interaction. Some of the main points are:

Technical quality

- Both panels and several interviewees think that SLU *is not sufficiently visible in society.* SLU's standpoint on certain key policy issues is perceived to be unclear. Problems are formulated and agendas set by others, and SLU is seen more as an extension of government.
- SLU is expected to be more at the forefront of *innovations* than is seen to be the case, given the high degree of relevance and potential of its operational areas.
- It is considered that SLU does not have a clear profile in the field of *commercialisation*. Although this issue is of fairly limited importance to the majority of stakeholders, SLU should be able to take on a more active role in launching important products and services on the market.
- SLU research focuses too much on problems and too little on solutions; thus, its *impact* is weaker than it could be. However, there is considered to be great potential in the form of business utility and policy impact.

Functional quality

- SLU is poor at *adding value* to its knowledge in the form of dialogue, packaging and communication of research findings. "*They possess a great deal of know-how and expertise that does not reach the outside world*". There is a lack of regular information from SLU and it is also considered hard to "*gain access*" to SLU research. SLU has limited interest in whether and how research findings are used, but the position differs from one area to another. Even initiated stakeholders consider that they have little knowledge of the areas in which SLU conducts research: "*Could it be that we do not know what research is being conducted, and therefore suggest priority areas for SLU research, even though the university already conducts high quality and relevant research in that field?*" Stakeholders also self-critically question the reception capacity in the sector itself.

- It is felt that SLU lacks a clear ability to take the initiative to establish *interaction* with public authorities, with trade and industry, and in relation to the academic world. Many fruitful joint projects and operations are heavily dependent on individuals, and are therefore vulnerable. SLU must be clear about what is on offer and what stakeholders can expect.

- SLU is receptive and good in the dialogue between individual researchers and stakeholders, although on a more general level it has an inability to "*look people in the eye, stick out its chin, or put its foot down*". There are general shortcomings in adapting to the changing world around it. In some areas, SLU is perceived to be timid in moving research forward towards analysis and evaluation. On the other hand, there is a perceived bias towards a more ideologically driven than scientifically founded approach in, e.g., the area of organic/conventional agriculture.

- There is a geographical as well as a mental gap between faculties and departments, which has an adverse impact on *capacity*. Concern is expressed over a perceived lack of focus (i.e. fragmentation) and setting of priorities. This is due to SLU's perceived inability to manage duplications and potential synergies between UoAs, faculties and disciplines at SLU itself, as well as in relation to other higher education institutions.

4.3 POSITIVE EXAMPLES OF IMPACT AND UTILITY

The in-depth interviews and the Stakeholder panels gave a number of examples (about 110) of projects, units, platforms and other activities at SLU that are considered very positive for interaction with stakeholders and society at large. This is not a complete survey of the impact of all SLU's research activities, since only a limited number of SLU's stakeholders were involved in the assessment.

The positive examples can be sorted into four categories:

- *Larger arenas, meeting places and platforms*

  Partnership Alnarp, "Fältforsk", Welfare Quality, Food expert Competence program ("Meny"), Centre for Sustainable Agriculture ("CUL"), Swedish Biodiversity Centre ("CBM"), The Swedish Species Information Centre ("Artdatabanken"), Farmers and Researchers together Program ("LOFT"), Food Academy ("Livsmedelsakademien"), Swedish National Forest Inventory ("RIS"), Centre for the Urban Public Space ("Movium"), The Swedish EIA Centre ("MKB-centrum")

Conferences and excursions are seen as good examples, as are special events such as those at the Stenhammar royal estate. Some good examples of research schools are: the Doctoral School in Genetics and the Degree Project School in Food and Climate.

- *Units, research areas and projects*

  This group includes more than 70 good examples of SLU activities (Appendix 7). Selections from different areas are:
  PlantCom Mistra, MicroDrivE, the Reindeer Husbandry unit, the Remote Sensing unit, Soil Management – Ploughless Tillage, Forest Consequence Analysis ("SKA08"), Voluntary Milking System Program, Environmental Communication, Green Rehabilitation

- *Publications*

  Some good examples mentioned are: Forest Facts ("SkogsFakta"), "Biodiverse", Trends in Environment ("Miljötrender"), Currents, Forest Management ("Skogsskötselserien"), Heureka End of Year Report, SLU's homepage (particularly the site on forest damage)

- *Participation by stakeholders in various SLU bodies*

  This category covers membership in SLU forums that are particularly appreciated by stakeholders: University Board, Faculty boards, advisory boards of education programmes, reference groups, working committees, etc.

The stakeholders were asked to specify typical features or success factors for the good examples chosen, as well as factors behind the less successful examples. The same factors seem to underlie success and failure but with reverse significance (when positive factors are absent, impact or utility will be achieved to a lesser extent). The factors mentioned were:

- research in the front line and of high scientific quality
- basic knowledge applied in current situations
- research with foresight, in relevant areas, giving substantial impact in current situations
- demand-driven research, solution and user oriented
- results with clear economic impact
- development and testing of products
- development of criteria/indicators for evaluation
- basis for development of high level of competence
- continuous interaction in early project stages with stakeholders and other competences bringing added value
- creation of an overall picture of an area
- interdisciplinarity, e.g. combinations of economics – biology – technology – environment – climate
- consequence analysis included

4.4 PROPOSED ACTION

In the light of the opportunities and threats in the world around SLU and the strengths and weaknesses within SLU, a number of measures have been proposed by the stakeholders:

Scouting and analysing the future surrounding world

The proposals for increased comparative analysis have a bearing on the way that SLU is perceived by the outside world, as well as the fact that SLU would be better able to identify future trends, tendencies and key needs of contemporary society. Stakeholders have emphasised the importance of "*both increased and continuous scouting and analysis of the future surrounding world* " as an essential means of operating in a rapidly changing and increasingly globalised society. In order to relate the results to SLU's own operations, the advice is that "*SLU must identify its areas of current strength, as well as those where there are gaps that cannot be filled by any other actor*", and also that "*SLU itself must be clear about what it can offer and what stakeholders can expect*". It is stressed that success is heavily dependent on having effective "radar", and that SLU needs to have a "*clear strategy for identifying the wishes of stakeholders*".

Wishes include that "*SLU must monitor and communicate new fields of knowledge about which the sector has limited information*". In order to ensure that research has a high utility, stakeholders should be involved at an early stage. In this way, research hypotheses can be formulated in such a way that the answer can be used in practical applications.

A clearer common vision/identity and strategy

As a consequence of the increasing complexity of the SLU sectors, as well as globalisation and increasing competition in knowledge development, stakeholders have emphasised the importance of SLU having a clearer and more living vision and a clear operational concept. Staff must recognise and identify with the vision, which should be based on SLU's core values and exploit uniqueness. Stakeholders consider that employees representing the University must be committed to SLU and the issues with which it deals.

SLU must stand up for the view that "*responsible use of natural resources by humankind"* is a positive concept. Research should focus more on solutions and less on problems in relation to issues concerning the green sectors. The Raw Materials for Energy and Industry panel stated that it is "*important for SLU to communicate that everything it does is essentially about sustainable production*."

One threat facing SLU is not being at the forefront or having a prominent position when the sector's image changes and resources are allocated. The paradox is that, as the sector's image improves, competition increases and it becomes more attractive for other players to enter the field and compete with SLU. SLU must make key strategic considerations in order to withstand this competition.

SLU should conduct research based on a holistic and systemic approach to a greater extent. It would be good for SLU as a whole to strengthen its profile in the social sciences. This is because "*environmental problems are societal problems*", and "*there is a need for research in the social sciences on the part to be played by natural resources in the society of the future*".

SLU must decide strategic priorities for the areas in life sciences on which it wishes to focus: no one can be best (in the world) at everything. SLU should also identify areas where there are gaps that are not filled by any other actor.

SLU's unique position in Sweden lies in research conducted in close collaboration with practitioners, which also enables it to create unique profiles in research fields related to, or shared with, other universities and institutions. Internationalisation is an essential strategy to meet global challenges. If it is to be a leading university, SLU will need international collaboration, with joint benchmarking and networks.

Development of leadership, organisation and working methods

The stakeholder panels suggest development of leadership and organisation, as well as rationalisation of SLU's working methods. Strong leadership will be needed at all levels to carry out the proposed changes, thereby achieving strategic priorities for the future. With strong leadership, focus on key areas, and assured project continuity, SLU can not only become leading in its research fields; it can make important contributions to positive developments in the community around it.

One of the steps proposed is that efforts be made to stimulate, develop and allow scope for good strategic leadership. SLU should develop its strategic leadership by focusing on leadership training and recruiting strong leaders. Several stakeholders have gained the impression of a poorly defined organisation and decision-making structure, and think that SLU needs to come to grips with this problem. This includes creating research teams with critical mass. It was noted that many researchers are obliged to manage numerous administrative tasks at the expense of research. It is suggested that SLU should provide improved administrative support.

Stakeholders from trade and industry, public authorities, as well as funding sources, meet the same research in several places. The advice to SLU is to eliminate duplications and overlaps.

SLU must be represented throughout Sweden in order to perform its mission of being a university for the whole country. It is a task of University management to cope with negative local loyalties that exclude others or distort competition. A researcher receiving an enquiry should act as a portal to the whole University, establishing contact with all those possessing the skills and knowledge capable of contributing to a fruitful solution.

Proactive communication/interaction of operations and research findings

Stakeholders call for more active and well-considered research communication and dissemination of knowledge. SLU should be more proactive in communication and press contact, i.e. be one step ahead of needs or demand, have the courage to show how good SLU research is, and communicate with new target groups. SLU should develop means of establishing a continuous and more comprehensive dialogue with end users of research findings. SLU should have a communication strategy for disseminating research findings and raising SLU's profile. How knowledge should be published and put to use should preferably be agreed upon right at the beginning of a project.

SLU core issues are at the heart of the current social debate. Examples include climate change, bioenergy and food supply. Yet SLU is not centre stage and must therefore work on its public image. One way in which SLU can have a broader impact in society is by deepening public debate, influencing decision makers and being reported by the media, which will in turn add to the impact of SLU, and of the green sector in general.

Stakeholders suggest a number of ways in which communication could be improved. It is suggested that research communication be made more efficient by use of online fact sheets. Researchers should be encouraged to take part in debates and be given media training. One suggestion is to identify individuals or research teams in SLU's strong/strategic research fields. These spokespersons or contact persons/groups would have the task of participating in public debate and "put SLU on the map" by being interviewed on TV, writing debate articles, etc. SLU could develop structured programmes, known as "focal points". At present there are a number of meeting places of this kind at SLU, such as CUL (the Centre for Sustainable Agriculture) or *Partnerskap Alnarp*, but there is a general need for more of them. In addition, SLU would be more visible at important conferences, e.g., *Energitinget* (an energy, climate and environment conference). Forms of continuous dialogue with end users can be developed, e.g., via reference groups, programme councils, interaction platforms and arenas in which sector and researcher can meet regularly. One panel said that "*We could make a useful contribution to SLU, but we are seldom asked, unlike Linköping and Mälardalen [universities]*". These proposals are testimony to the fact that communication does not develop on its own, and that SLU must establish a communication culture.

There are too few incentives for researchers at SLU to turn to the outside world with their findings. These limited practical applications of research findings result because SLU researchers do not gain enough academic credit by engaging in applied research. SLU must therefore change this. There is a need for an internal reward system for popular scientific publications and other means of communicating results.

Packaging operations for increased practical applications and impact

From a stakeholder viewpoint, it does not always suffice that research is of high scientific quality. The practical applications and impact of SLU's operations would be considerably greater if the University succeeded in packaging and presenting its research activities in a better, more user-friendly way, more adapted to the needs of the situation than is currently the case.

Stakeholders would like to see a holistic approach, in which both research and education are conducted systemically, for example the farm (a system where food and energy are produced in parallel), or in "value chains" (from production via process to the consumer). Some examples are:

- Research and education on food: The entire food chain must be taken into account. Many research areas and sectors can be interlinked, so that no parts can operate in isolation from each other.
- Production-oriented research: Economics, organic production, systems analysis, management and water issues should be linked to the more traditional agricultural subject areas.
- Management of large dairy cattle herds: This is a complex area that requires more of an overall approach than the research generally conducted in dairy production.
- New research fields, e.g., the relationship between humans and animals, and the impact of domestic animals on environment and climate.

The view that SLU should gather knowledge together in a larger context by way of syntheses, a holistic approach, systems analyses and an interdisciplinary approach has very strong support in both the public and the private sectors. However, it is not expected that individual researchers or even SLU should do all the work; the best approach is to involve all skills, internal as well as external, including other universities. SLU should be a leading partner, using initiative and leadership to assure continuity, and controlling and developing projects and processes. Compared with other universities, SLU has unique potential to use its in-depth knowledge of its core areas to adopt a systemic perspective and a holistic approach.

Interaction and rationalisation

Internal

Regarding SLU's internal interaction, stakeholders would like to meet a cohesive SLU. Frequent reference is made to inter-faculty "bickering", as well as fragmentation, i.e. that individuals are responsible for their own sphere, without interacting with others. Many research teams are very small, and therefore lack the resources for persistence, efficiency and utilisation of findings. One panel concluded that faculty and departmental boundaries must be crossed: "*Strong leadership is needed at all levels*."

The funding system and competition for funding are factors contributing to the perception of SLU as fragmented. The perception that different parts of SLU duplicate one another is often pointed out, for example: "*Why does SLU want to have two centres (Alnarp and Ultuna) for landscape architecture*?" Top priority should be given to improving internal communication between SLU subject areas, so as to avoid overlaps and to optimise resource use.

External

Stakeholders emphasise the need for SLU to create synergies between different parts of the University, and with other higher education institutions, to enable it to cope with the increasingly intensive global competition in the market for knowledge, skill and know-how. SLU should feature clear spearheads, based on the premise that it cannot be best at everything, particularly not within the broad area it is endeavouring to cover.

Globalisation entails greater competition in the global research arena. "*An increasing proportion of total research resources in Europe are being channelled via the EU system, which means that international partnership is needed to compete for research resources*." Collaboration and networks can assume many forms, and in terms of *staff mobility*, it is a question both of researchers and teachers working outside SLU, and of researchers and teachers coming to the University. SLU must identify potential partners at other higher education institutions, and create relevant networks to assure continuity of research.

Priority subject content

Stakeholders have called for more research in some 80 areas (Supplement, R 4). These include:

- Animal medicine-human medicine models, e.g. cancer, allergies
- Forest, food and agricultural technology (both research and education)
- Systems analyses/interdisciplinary research, including economic perspectives, e.g., economics and climate effects of energy supply alternatives
- Cost-benefit analysis of animal health, e.g., different treatment methods
- Management and animal health in large animal production units
- Rural development in developing countries
- Biological raw materials for industrial production and product development
- Sustainable production in agriculture and forestry, including organic production
- Hydrology and aquaculture
- Risk analysis principles as a basis for international food legislation
- Quantitative plant genetics in agriculture and in forestry
- Added value in raw materials, including consumer preferences

Image

It has been pointed out that SLU's essentially good image, coupled with the changes in the right direction being implemented by current University management, is a strength. It is also proposed that SLU should continue to develop and strengthen its image. However, the fact that SLU does not carry its name with pride, i.e. that insufficient support has been generated internally for the identity, brand and logo of the entire University, creates external uncertainty about SLU's role and identity. SLU is also perceived to have different images in different regions, which also creates a lack of clarity. With regard to the name of the University, one of the panels held the view that SLU should seriously consider changing its name. The panel's suggestion was "the Swedish University of Natural Resources". Another panel suggests retaining the name, since it is a strong brand, to be fostered for the future.

5 EVALUATION OF ENVIRONMENTAL MONITORING AND ASSESSMENT (Foma) - RESULTS AND ANALYSIS

5.1 SCIENTIFIC EVALUATION

5.1.1 About the assessment

Of the 130 UoAs included in the peer review of research, 31 are also active in Foma. These units are distributed over 11 research fields/panels, the majority being within Soil and Aquatic Sciences, Forest Management and Products, and Ecology and Environmental Sciences. The peer review by the Scientific panels did not include four important units that are solely dedicated to Foma (Appendix 6), because they do not have any research activities of their own. However, two UoAs that are devoted exclusively to Foma were (inconsistently) included.

The panels were instructed to assess Foma operations on the same principles as they did research (Appendix 2). Thus, the evaluation criteria were Quality, Recognition and Leadership; Relevance and Impact; and Strategy and Potential; however, the panels were not instructed to give scores. As in assessment of research, the basis for evaluation was written self-assessments, in which the UoAs described content, strengths, weaknesses, strategy, etc. for their Foma activities, as well as oral interviews.

In general, the panels' comments on Foma (Supplement R 2) were less detailed/elaborated than the comments on research (in some cases they were very scanty), which is natural considering that the main emphasis in KoN was on research. Although the scientists in the panels were selected specifically for their research competence, many have experience relevant for assessing Foma. In certain instances the panels had some difficulty in differentiating between research and Foma, i.e. the distinction is not a clear-cut one.

5.1.2 Results and analysis

Quality, Recognition and Leadership

The lack of scores, in combination with the variable level of detail in the panels' comments, precludes a relevant ranking of individual UoAs. Nonetheless, some units received markedly positive comments on the quality of their Foma operations:

The Forest Management and Products panel stated that *"The Swedish National Forestry Inventory is recognised as one of the world-leading in terms of methodology and implementation efficiency"* (260-4). In Soil and Aquatic Sciences, two units were particularly praised: "*The group is recognised as a leader in Europe and internationally on design of monitoring networks"* (Aquatic Geochemistry and Environmental Chemistry, 280-1). "*The UoA has substantial Foma operations which it executes to a very high standard*" (Aquatic Ecology and Biodiversity, 280-2). The Ecology and Environmental Sciences panel identified the Systems Ecology (415-8) unit as prominent: "*The Foma operations of this UoA enjoy outstanding quality, excellent recognition and leadership..*", and the Wildlife, Fish and Environmental Studies unit (251-1) was also praised: "*The quality of these [monitoring] programmes seems top notch*".

Relevance and Impact

The panels in general appeared to be very impressed by the value of Foma to society, and their reports stressed the important implications of the work for the fulfilment of national and international commitments on environmental issues. Many units were praised for having very high relevance and impact for policy makers and in areas such as practical forestry. The Wildlife, Fish and Environmental Studies unit (251-1) was complimented for their way of involving stakeholders in data collection: "*The unit may be considered exceptional, particularly on the wildlife side, in its ability to portray its relevance to end users*". Another UoA that was appreciated in this respect was Soil Carbon and Greenhouse Gases (435-1): "*The unit has understood the growing need for environmental assessment to serve decision makers with comprehensive analyses. They have extensive contact and interaction with stakeholders…*"

Synergy and integration between Foma and research

SLU is unique in that environmental monitoring and assessment is brought into the research sphere, and the mutual benefits of Foma and research are recognised by the panels. The collection of high quality data in Foma was described as a highly valuable resource for the research community, and collaboration often results in co-authored scientific publications. One example is the Remote Sensing unit (260-3), which serves as a data and map provider for other projects and applications. Research in the Biostochastics unit (300-1), for example, contributes by developing quality assessment methods. Thus, the two operations clearly support each other.

In specific units, many have achieved a good working balance between research and Foma, e.g., Ecotoxicology (713-1): "*The Foma activities of the unit perfectly complement its research activities*", and Ecology of Cultivation Systems (500-1): "*There are strong synergies documented between research and environmental monitoring and assessment*". However, there were cases where the two operations were carried out in isolation from each other and where the data gathered in Foma activities were not being used by the UoA for modelling work, for example. In a few instances the panels commented that time-consuming Foma activities may sap time and energy from research, particularly in small units.

One panel pointed out that a heavy reliance on Foma funding causes vulnerability, and may also hamper the general development of the UoA: "*…the dependence on Foma funding can result in monitoring dictating the research agenda unless care is taken to keep a broader perspective*".

Potential for development

There are several UoAs that have only recently become involved in Foma; others currently have no Foma activities but have expressed an interest in contributing to Foma programmes. The panels have identified scope for developing new dimensions of Foma, in e.g., economics, forest diseases, and animal and human health. However, they point out that a lack of funding may prevent the full potential from being realised.

5.1.3 Conclusions

Recommendations differ according to the varying status of Foma at the individual UoAs, but some patterns appear from recurring remarks:

Interaction between Foma and research

Several UoAs would benefit from improved interaction between Foma and research. They need to develop a clear strategy for how to best make use of Foma activities and the unique data series produced over many years in research, e.g., modelling and synthesis. One panel expressed it thus:

"*One of the keys to future success will be to better exploit the enormous potential synergies between the Foma monitoring data and the research expertise of the UoA".*

International links

Some units are advised to broaden their geographical scope to the international level, and to actively search for further national and international collaboration. This would serve to promote development in methodology, increase the impact of Foma and enhance international visibility.

Stakeholder interaction

Although many units are commended for good interaction with stakeholders, others need to pay more attention to this aspect. One panel wrote of one unit that it "*…. will only be really successful if it manages to be a fully operational platform for … data in relation to the demands of the stakeholders*". Another panel suggested that public outreach of Foma in general would benefit from better centralisation.

Data quality and availability

In some instances, the panels stressed the need for UoAs to increase the availability of data for research as well as for other use. Another aspect mentioned is the vital importance of long-term data collection: "*The panel considers it extremely important that a core set of variables be monitored over a long period"*; and *"…the value increases each year of continuous monitoring".*

Funding

The panels have identified several interesting opportunities for developing new dimensions of Foma. If this perceived potential is to be realised, SLU will need to consider the funding situation. As one panel said: *"…it is clear that for such long-term projects to provide benefits, long-term sustained funding will be necessary*".

5.2 STAKEHOLDER PANELS

The results and analyses in this section are based on the in-depth interviews and the report from the Foma Stakeholder panel (Supplement, R 4).

5.2.1 General observations

The results of the evaluation of Impact and Utility reflect stakeholders' perceptions of quality, i.e. how they *perceive* SLU (Chapter 2.4). Thus, any expectations that the panels would evaluate all Foma operations in detail have not been met.

Overall, stakeholders give Foma a positive evaluation: "*Foma has a high standard*". Foma operations are seen as important for future societal planning, monitoring of natural resources and attainment of environmental objectives. Foma's operations are also of great importance to stakeholders. In addition to this, the Stakeholder panel considers that Foma's current operations and structure are in most respects highly effective. The panel also considers that Foma programmes are carried out with a high degree of commitment and professionalism. However, there are organisational and other aspects of Foma that should be improved, so as to derive more and better utility from Foma.

5.2.2 SWOT analysis

Opportunities and threats

The *opportunities* are that Foma can:

- increase collaboration within SLU and with other national and international organisations
- use modern methods to make data available for analysis, research and follow-up
- use the modelling know-how existing in other parts of SLU, e.g., to predict the effects of changes in climate, land use and management methods
- develop education and training courses with material based on the experience gained from Foma
- supplement know-how through strategic partnerships.

The identified *threats* to Foma are:

- uncertain long-term basic funding
- results not being reached or understood by users
- inability to attract and keep qualified staff.

Strengths and weaknesses

Foma's strengths and weaknesses are presented in further detail on the basis of the four themes and ten key words described in section 2.4.2. Fig. 6 shows the structure of stakeholders' comments on the basis of how they perceive Foma's strengths and weaknesses. The comments have also been structured in terms of how they relate to *Technical quality* and relevance, i.e. Foma's content and orientation ("what"?) or whether they focus on *Functional quality*, i.e. Foma's working methods and approach ("how?").

The assessment made by the Foma panel accords very closely with the in-depth interviews and the assessments made by the other Stakeholder panels. However, there are differences on a number of points; for example, Foma is considered to have more intensive interaction and dialogue with the world around it. Value added to findings and impact are also considered to be greater strengths for Foma than is the case for research as a whole.

	Weak ⟷ **Strong**	
What? **(Right thing)**	Democracy/society Innovation Commercialisation	Expertise/skill Knowledge development Utility Impact Recruitment base
How? **(Right way)**	Value added Adaptability Capacity	Independence Openness/accessibility Interaction

FIGURE 6. *Strengths and weaknesses. The structure of stakeholders' comments on the basis of how they perceive SLU's internal strength and weaknesses. Lateral placement indicates the degree of strength or weakness. For example, democracy/society is not seen to be as weak as commercialisation.*

Strengths

Stakeholders consider that Foma maintains good *Technical quality* i.e. that the right things are mostly being done. They also consider that Foma is very important to them. Present operations and structure are in most respects highly effective, and programmes are being carried out with great commitment. The experience of the Stakeholder panel is that SLU has been a good recruitment base for other public authorities and companies.

As regards *Functional quality*, it is considered that programmes have been carried out with great commitment and professionalism. Examples mentioned are the Swedish Species Information Centre, the Centre for Chemical Pesticides and the National Swedish Forest Inventory, which, in exemplary fashion, have made available material of major importance for stakeholder policy decisions and of great interest to the public.

Weaknesses

A recurring comment concerns Foma's ability to create *enhanced* utility: more types of utility for existing stakeholders and an untapped potential utility for players other than those currently closely affiliated to Foma. The Stakeholder panel also focuses on the absence of comparative analysis, the invisible operational concept and an indistinct management structure.

As regards *Technical quality,* the priorities between programmes seem largely to be historically based, and are perceived by the panel as difficult to understand. According to its mission statement, one of Foma's tasks is to assess environmental problems. However, there is no clearly defined strategy as to how this assessment should be carried out. At present it is done *ad hoc*, and it is unclear how and where the various programmes choose to draw the line between presenting results and forming opinions based on the results. The climate impact programme has potential but has not yet gathered its forces to focus on climate change issues.

In the area of *Functional quality,* views were expressed on the operational concept, which is perceived to be unclear, invisible and giving too "narrow" an impression. Furthermore, it does not have an impact on operations. It is noted that although no commercialisation of any Foma operations, aside from a number of services that are sold, has been presented, this is not a major task.

Much of the work done under some programmes focuses on models. In other areas these are absent. Although the essence of Foma's operations is data gathering, the panel considers that development of models and data gathering should go hand in hand. Neither collaboration with other universities nor international cooperation within Foma has been highlighted in the presentations. One important area in which the potential is not fully exploited is interdisciplinary collaboration. Resources do not seem to have been focused on the Foma programmes. The scouting and analysis of the future surrounding world is not clear, and it is not possible to see that the position adopted by SLU is well-considered in policies and procedures. There are a number of doubts about management and control of Foma, e.g., responsibility, decision making, production of ideas, prioritisation, and interaction with research and users.

5.2.3 Proposed action

A number of measures are proposed by the Foma panel with a view to increasing mutual benefit/utility and impact. These primarily relate to the following areas:

A clearer common vision/identity and strategy

The operational concept should be clarified, developed and made more visible externally and internally. It should give a broader impression than is currently the case, and its impact on operations should be evident. Development should take place in collaboration with external stakeholders.

The operational concept should be refined and defined in operational descriptions and programme declarations. Foma should also develop a strategy on whether, and if so, how, it should "*form opinions based on the results or merely supply information*". Further, there should be a strategy for the supply of specific skills in, e.g., statistics, communication, and GIS analysis. Strategic thinking is proposed in relation to external partners, with a view to obtaining mutual benefit from additional know-how.

Scouting and analysing the future surrounding world

The panel proposes an additional comparative analysis that takes account of factors other than the explicit environmental objectives forming the basis for Foma's operations. The analysis should be carried out jointly with stakeholders (perhaps in collaboration with a broadened reference group). There should be clear methods of assessing achievement of environmental objectives and compliance with legislation. Other general processes, future environment and production scenarios, etc. should be incorporated in the analysis, resulting in material forming the basis for Foma's operational concept, operational description and programme declarations.

The comparative analysis should include monitoring of ongoing research in the field, evaluation and decisions in relation to new technologies for data gathering and development of models.

Development of leadership, organisation and working methods

A more clearly defined management structure and clearer priorities are proposed. Foma should have a decision-making steering group, comprising those with general responsibility for allocation of funding and those responsible for Foma programmes and follow-up. Foma should also have an active advisory group composed of a broad group of stakeholders, including NGOs and sector representatives. Programme coordinators should have clear mandates. The importance of having clearly defined career paths is emphasised.

To break up the vertical structure, a change in the organisation is proposed, with clusters of programmes, and possibly larger programme units. The panel also proposes that collaboration between existing programmes should be developed to make use of overlapping or complementary skills, create critical mass and simplify resource allocation. Larger clusters will provide better opportunities and greater staff resources for operations that complement Foma, i.e. research, scientific publication and communication. Increased collaboration internally, externally (including other universities) and internationally is seen as a challenge for the future.

Proactive communication/interaction of operations and Foma results

The panel observes that operations and findings could be better presented, so that they are more widely known and results available among researchers, stakeholders and the public. This will require different information channels to be used for different groups. Information must be adapted to meet the needs of various groups, e.g., by use of new technology, new products to disseminate information and by choice of language. Operationally, this can be developed in information plans for each programme.

Foma should use and participate in existing networks for information dissemination. New internal and external arenas are also proposed. One example is an annual "Foma Conference", to help better integrate SLU skills and tasks. Foma ambassadors are needed within and outside SLU. They must have good knowledge of the data archives and resources for which SLU is responsible and be able to see the potential in analysing those data to produce results on which to base decisions on current issues. Participation in the current debate is therefore important.

Managing operations for increased practical applications and impact

Even though the Scientific panels of many UoAs emphasise the great value of combining research and Foma operations, the Stakeholder panel points out that more could be done in several of the programmes to make better use of the research available at SLU. In particular, the modelling know-how elsewhere at SLU could be of benefit to Foma, as could collaboration with economists and social scientists.

The panel thinks that methods to evaluate environmental problems should be developed together with stakeholders. What is considered an "appropriate evaluation" may vary, depending on the question at issue and the decision-making situation. Alternative solutions should be described and their impact analysed more often. The focus should be on producing well-balanced results on which to base decisions, e.g., a balance between biodiversity and yield.

Data must be accessible using modern means, internally and externally, for analyses, research and follow-up. It ought to be possible to make more use of the Swedish Species Information Centre's methods of gathering data by involving the public if it can be ensured that the results are statistically safe. The Centre is also a model for providing better access to data for the public.

6 QUALITY AND IMPACT – SYNERGY OR CONFLICT?

6.1 THE KoN APPROACH

Like other Swedish university-wide research assessments, the main focus of SLU's Quality and Impact evaluation is on scientific quality, as measured by peer review. Although other assessments (mainly KTH's) have taken into account the impact of research on industry and society, SLU's evaluation has gone much further in striving to obtain stakeholders' views of the relevance and usefulness of research.

As described in section 2.4, the evaluation of Impact and Utility has comprised in-depth interviews with stakeholders, as well as comprehensive assessments of broader areas by Stakeholder panels. Both have given valuable input, from slightly different angles; thus, the KoN approach has been successful.

In addition, the scientific evaluation included assessment of Relevance and Impact of research (2.3). Similarly to the KTH evaluation, each scientific panel included stakeholder representatives, who were carefully selected for their broad experience as "qualified users" of research results. At the post-evaluation meeting with the KoN Management Team, this model was unanimously commended by the panel chairs, who stated that the stakeholder representatives had made valuable contributions to the discussions on the relevance of research to industry and society, and also provided valuable specific information on Swedish (Nordic) conditions. It should be stressed that the assessment of the Scientific Quality criterion was carried out on strictly scientific grounds, i.e. the assessments were not influenced by aspects relating to the usefulness of the research for stakeholders. On the other hand, the Relevance and Impact criterion took full account of aspects of usefulness.

The general conclusions and recommendations from the two main elements of the evaluation – Quality (Scientific panels) and Impact and utility (stakeholders) – were largely similar, e.g., both stressed the need for SLU to strive for high research quality, to increase its focus, sharpen strategies and improve internal coordination. For some, this concordance may be contrary to expectations, the traditional view being that (most) users of research only have narrow, short-term interests close to application.

6.2 IS "QUALITY" A PREREQUISITE FOR "IMPACT"?

SLU's stakeholders firmly believe that high scientific quality is essential if research is to be valuable for their needs. Thus, in order to be an attractive partner for stakeholders, SLU needs to provide the most modern technologies and be at the scientific forefront. SLU needs to continuously strive to achieve scientific excellence to compete successfully for funding, not only from research councils but also for commissioned projects and collaborative programmes involving industry. Companies

and organisations, including smaller ones, increasingly choose to fund projects where the best expertise can be found internationally. Even in Sweden, SLU is no longer the only player within research fields that have been traditional "SLU territory".

In the Scientific evaluation, there was a significant, moderate correlation between high Scientific Quality and high scoring for Relevance and Impact (Spearman's Rank Correlation). It is clear that excellence in science is no obstacle to achieving high impact and utility. This finding corresponds with the results from a survey covering 30 Swedish universities (Wahlbin & Wigren 2007), in which researchers with high scientific publication were more active in external relations. However, a strong commitment to extension service and outreach, for example, does not necessarily coincide with high scientific excellence.

6.3 SHOULD ALL RESEARCH AT SLU BE "IMPACT"-ORIENTED?

SLU cannot and will not compromise on the scientific quality requirement. Moreover, the freedom for researchers to choose research problems within their subject area is a fundamental principle at any university. On the other hand, outreach and innovation are natural components of a university's task/activities. At university, faculty and UoA level, this responsibility must be taken seriously. However, it should be stressed that not everyone may necessarily be engaged in outreach or innovation, and over time individual scientists may also vary in their specific attention to different aspects of a subject.

Impact is not generated by applied research only. There are numerous examples of "basic" research generating results that are directly applicable in industry or society. An illustration of this is given in Fig. 7, where research is classified according to its drivers.

<table>
<tr><td rowspan="2">Quest for fundamental understanding?</td><td>Yes</td><td>Pure basic research
(Bohr)</td><td>Use-inspired basic research
(Pasteur)</td></tr>
<tr><td>No</td><td>--</td><td>Pure applied research
(Edison)</td></tr>
<tr><td colspan="2" rowspan="2"></td><td>No</td><td>Yes</td></tr>
<tr><td colspan="2">Considerations of use?</td></tr>
</table>

FIGURE 7. *Pasteur's quadrant. Classification of research by whether it advances human knowledge by seeking a fundamental understanding, or whether it is primarily motivated by the need to solve immediate problems (Modified from Stokes, 1997).*

For a sector university such as SLU, the ideal situation would be to have the majority of its research in the upper right-hand corner – "Pasteur's quadrant". However, both needs-driven and curiosity-driven research have their own *raison d'être* at SLU. The important point is for SLU to create an environment and a culture that enable and stimulate researchers to pursue communication with stakeholders and activities in outreach, innovation, etc., so that good opportunities – and thus societal "Impact" – are not lost.

6.4 DOES "QUALITY" BENEFIT FROM "IMPACT"?

In the study reported by Wahlbin and Wigren (2007), most respondents said that cooperation with the surrounding society had a positive effect on their academic career. "*Regarding academic integrity and freedom, the number of respondents saying that academic integrity and freedom increase through joint projects with the surrounding society is equal to the number saying they do not*". Interaction with stakeholders often provides new ideas for curiosity-driven research. Thus, there are clear mutual benefits. The best units often successfully combine curiosity-driven and needs-driven research and several examples of this are given in the KoN evaluation. These units set an example for others on ways of combining research of a high scientific standard with interaction with stakeholders on practically oriented issues. In the words of one of the scientific panels: *"Doing the one is no excuse for not doing the other"*.

7 RECOMMENDATIONS

7.1 INTRODUCTION

Scientific quality is generally considered to be good at SLU and research conducted by several UoAs is of a high international standard and even world leading in some cases. Both Scientific panels and Stakeholder panels stressed that good and sound scientific performance is a necessary basis for the application of results in industry and society. The impact and utility of SLU's research is appreciated and many good examples are mentioned. However, there is also a wide array of suggestions given both by the Scientific and the Stakeholder panels for improvements at various levels in the University.

This chapter includes recommendations based on an integrated analysis of the major conclusions and suggestions from the two panel categories (Scientific panels and Stakeholder panels). Since the opinions and suggestions for improvement show a remarkable similarity (Chapter 6), recommendations from both panel categories are treated together. The recommendations are intended to be processed and implemented at various management levels at SLU.

One specific and important proposal is to bring knowledge from different disciplines, both from SLU and from other organisations with complementary knowledge, together in a wider context to support more valuable solutions. This idea is elaborated in Chapter 8.

7.2 GENERAL RECOMMENDATIONS

The purpose of the recommendations is to strengthen the scientific quality and the impact of SLU's research and Foma in relation to the SLU mission on the way towards SLU's vision, established by the SLU Board in September 2009 (Chapter 8).

Scouting and analyses of the future surrounding world

Both Scientific panels and Stakeholder panels considered that SLU must strengthen its analyses of external factors and influences (trends and tendencies) and increase future perspectives. This should be done in order to increase quality and competiveness, as well as to develop utility and interaction with society. The analyses should include both internal observations and external scouting.

Recommendations

SLU should form an analytical "think tank", comprising people with leading positions in academia, industry and other organisations outside the University. Members could be national or international, preferably with an SLU connection. This "think tank" will support the University Board, the Vice-chancellor, and the University Senior Management Team in strategic decisions by performing future analyses and will thereby also help the University to become more proactive.

Several internal "think tanks" should also be formed. By creating internal groups, SLU should be able to make better use of the wealth of knowledge and networks possessed by SLU researchers, as well as their interest in developing the University for the future.

Strategic thinking

In general, there are serious concerns about strategic thinking in all research fields and in many of the individual UoAs. A number of UoAs received fairly low scores on the Strategy and Potential criterion. The future development of SLU is heavily dependent on having unit leaders capable of strategic thinking. It is particularly important that more senior leaders are able to think outside the box" and practice strategic thinking that will benefit the whole of SLU, not only their own subset of the organisation. SLU should intensify training in academic leadership combined with strategic thinking. It will be useful to identify UoA leaders successful in formulating and implementing research strategies for larger groups, and transfer their experience to other scientists via open seminars.

Recommendations

Both present and future leaders, in particular senior management staff responsible for carrying an SLU identity ("*identiphores*"), should take advanced training courses in strategic thinking and management adapted for the academic environment.

To ensure long-term continuity and development, it is recommended that the mandatory courses for PhD supervisors should include basic elements of strategic thinking.

Experienced research leaders with documented skills in strategic thinking and management could give inspirational seminars on this topic at the annual SLU meetings for departmental heads.

Leadership

The need to strengthen and develop academic leadership at different levels was recognised by many of the Scientific panels. Important aspects of successful leadership are the capacity to inspire and motivate colleagues to focus on common visions and missions, strategic thinking and communication.

Recommendations

Academic leadership at SLU should be developed by way of several activities such as courses, training and seminars. These activities should be seen as a complement to ongoing administrative management courses. Academic leaders such as heads of departments and PhD supervisors should be supported by a system of mentorship and networks (Haikola 2000). Leadership capacity and experience should be considered more thoroughly in recruitment processes for higher positions (professors and senior scientists).

Succession planning

It is quite obvious that SLU currently faces a major challenge in the form of new appointments, as many positions, particularly professorships, as well as other positions, become vacant. Several Scientific panels expressed strong concern over succession planning, which is considered not to have been satisfactorily resolved in many instances. The process often starts late, which creates an uncertain situation for the unit; a vacant professorship almost always has an adverse impact on operations. The panels pointed out that low scores were awarded to some UoAs because succession had not taken place (or was substantially delayed).

Recommendations

SLU faculties and departments are strongly recommended to substantially improve the succession planning, to speed up the process of filling leading positions, and to clearly communicate their intentions.

Focus in research/ Profile areas

The Scientific panels and Stakeholder panels both expressed concerns that research is often very broad and fragmented. There is a general lack of focus and an absence of larger, coherent research areas.

SLU, as a sectoral university, has a particular responsibility to provide basic and applied research in key areas for the green sectors. SLU has very strong and vital research of high international standard, even world excellence, in several profile areas. However, it was noted with surprise that SLU has weaker, and in some cases poor, scientific performance in several applied research fields that are of fundamental importance for educational programmes and of great relevance to stakeholders.

Recommendations

SLU should make strategic decisions, concentrate on fewer areas and more clearly include major global and national challenges such as climate change and sustainable development in its focus areas.

SLU cannot cover and be excellent in all fields. The University should thus make strategic decisions at all levels to become more focused in its choice of research themes, including a concentration of resources.

It is strongly recommended that SLU and its faculties adopt a long-term strategy of identifying profile areas, basic and applied, that should be central features the SLU of the future. These profile areas are essential to favourable development. SLU should plan to develop scientific excellence in all these areas.

Collaboration and synergies

Almost all panels stated that SLU has too many research units that are undersized and have low "resilience". There are many instances of quite substantial overlaps and a lack of collaboration between units, departments and faculties, causing unnecessary competition for external grants. The reasons for this situation are manifold; some units are the result of recent reorganisations, some are new and developing. In addition, some units were put together solely for the KoN evaluation, mainly comprising researchers otherwise working essentially alone. This situation renders the SLU organisation vulnerable and suboptimal for development of excellence in research. The scientific evaluation clearly reveals a strong positive correlation between team size and performance under all four evaluation criteria. SLU has started the process of creating larger units with critical mass by forming larger departments, and this should continue. However, a certain overlap is unavoidable due to the requirements of educational programmes at the various campus locations.

SLU has "strategic locations" on four major campuses in Sweden, in close contact not only with regional industry and communities, but particularly with some of Sweden's largest universities. The panels found that synergies and collaboration have evolved to some extent, but pointed out the great potential for SLU to further develop these contacts and potential partners.

Recommendations

SLU should take active steps to create larger research units – either by cooperation, or by coordination between (and in some cases also within) units. This must improve substantially in order to reduce overlaps and increase synergies. Numerous suggestions of ways in which individual research units can increase collaboration with other units are made by the panels (7.3). Many small units should be linked to, or integrated in, larger units. This will help to achieve critical mass and improve cooperation, thereby enhancing research quality. It will help make units more stable, easing succession, and reducing overlap and unhealthy competition.

Virtual or real meeting platforms should be created, and regular seminars/workshops/ planning meetings should be arranged in thematically close areas (e.g., between campuses, departments and faculties). These platforms will be the natural and most appropriate way of establishing a number of new Centres, as suggested by several panels (7.3). New, larger research areas across faculty borders will generate greater synergies.

Contact and collaboration with neighbouring universities should be substantially deepened and developed at SLU's four main campuses.

Intellectual infrastructure and technology platforms

The Scientific panels concluded that SLU's presence across Sweden yields many advantages, but there are also drawbacks. The geographical, and often also intellectual, separation of SLUs faculties and campuses may cause isolation and suboptimal development. To promote efficiency and sound scientific development, SLU must improve infrastructure systems.

Recommendations

SLU should provide joint technology platforms and appropriate expertise in several fields to be used as support for all scientists at the University, particularly in the following fields:

- statistical consultation
- bioinformatics
- mathematical modelling
- systems analysis
- "omics" of various kinds

Owing to SLU's geographical separation, it is an urgent priority to create a number of meeting places at and between campuses to develop the intellectual environments for stimulation of academic discussions, workshops, seminars etc. The ongoing concentration of resources at all SLU campuses will improve the scope for virtual and real meeting places, as well as shared use of equipment, but SLU should make renewed efforts in this area. Communications equipment must be continuously updated.

SLU should initiate a number of larger research programmes across faculty borders to promote scientific development and increase collaboration (Chapter 8).

Communication and outreach

Both the scientific evaluation and the assessments of impact and utility clearly indicate that SLU could improve communication activities at all levels. Panels noted that while the scientific quality of research at many units is generally high, the impact of journals selected for publication is often not as great as it could be.

While communication with peers through scientific publications and oral conference presentations is a natural part of research activities, communication with the general public comes less naturally to most scientists. The need to elucidate and make results, knowledge, expertise and skills more visible in a more comprehensive and accessible way was expressed in the stakeholder assessment. Stakeholder interaction could be increased by development of arenas for exchange, joint formulation of research issues, etc.

In most European countries advanced extension services and development for industry and society at large are performed by state institutes separate from universities. State institutes are much less common in Sweden than in other countries, and Swedish authorities consider the "institute role" to be included in SLU's mandate. The Swedish Government has recently estimated the cost

of this role to be SEK 140 million, which is included in the annual budget appropriation to the University. It is obvious that SLU's sectoral/institute role can be further developed, and the views of the Stakeholder panels are of particular value in this context.

The Stakeholder panels pointed out that although SLU's image is essentially good, there is still some uncertainty about its role and identity. Stakeholders think that SLU should become better at managing differences of opinion within the University, and make it clear in debates which arguments are based on scientific grounds, and which are ideologically based.

Recommendations

SLU should develop a communication strategy including a supporting communication culture, capable of being implemented at different organisational levels. The strategy should cover both internal and external communication, and define priority areas and stakeholders. Important issues are entry points for stakeholders with searchable information on results, knowledge, contacts etc., packaging of research and Foma findings (synthesis documents, area compilations, etc), and analysis of the absorption capacity of the stakeholders in relation to SLU's transmitter capacity.

Senior SLU leadership should be offered special communication courses, including media training and rhetorical skills. Communication elements should be substantially increased in courses for PhD students.

SLU should organise open conferences on topical matters, e.g., bioenergy, animal welfare, quality aspects of organically farmed foods, and publish synthesising "green policy papers" on controversial issues, covering opposing standpoints and frames of reference without striving for consensus. Here, SLU must make it clear that its role as a university prevents it from adopting an "official" position.

SLU scientists should review their preferences for journals for manuscript publication and strive for publication in high impact journals. Communication with the general public should be encouraged by the management, and information about research at SLU could be increased by popular science articles, leaflets, newsletters, web information, etc.

The University should assume greater responsibility for a better dialogue and cooperation with stakeholders in the green sectors. An efficient extension service should be developed that is capable of combining current scientific problems with stakeholder needs. SLU should speed up this process and increase the number of planned "extension service" positions.

SLU should establish a system of indicators for measuring quality of activities relevant to communication, extension and other central aspects of the "institute role", drawing upon the experience gathered by other sectoral universities, e.g., Luleå University of Technology (Johansson 2009) and MIT (Hersey 2008).

International links

SLU generally has a good international reputation and belongs to an extensive network of institutions and universities around the world. However, several Scientific panels stressed the need for greater participation in international networks. International mobility must be improved at all levels. The Scientific panels found in many cases that exchange, particularly at senior scientist level, is poor. There are surprisingly few senior scientists at SLU who take the opportunity for sabbatical leave or other types of research visits at other departments for shorter or longer periods. It was noted that there are generally few visiting scientists at SLU. The Stakeholder panels concluded that close international collaboration is a prerequisite for developing and maintaining a high standard (including applied research and Foma) at SLU.

Recommendations

SLU should encourage senior researchers to visit and work for shorter or longer periods at highly ranked scientific departments in other countries. This could be done in a formal framework of sabbatical leave subject to clear conditions laid down by the University. Additionally, SLU should increase international training at junior level, e.g., encourage PhD students and post-docs to spend time working at institutes or university departments abroad. International exchange should also be increased in environmental monitoring and assessment.

SLU should create an arena for inviting experienced scientists from other countries to visit SLU, for example, by offering temporary guest professorships, scholarships for visiting scientists or other types of grants (available from research councils and other sources).

Activities in developing countries

SLU's substantial research focusing on developing countries is noted, and in general appreciated, by the Scientific panels. However, they also stressed that this activity is highly fragmented and uncoordinated. Some units are even working in the same country, without contact or synergies with each other. Panels questioned the capacity of small units to conduct research both in Sweden and developing countries, since this has resulted in highly fragmented research. Several units or departments are only marginally or not at all involved in research aimed at the developing world.

Recommendations

SLU should strengthen research focusing on developing countries and create a platform for efficient coordination of ongoing and future activities, together with funding agencies. Further engagements in developing countries should be encouraged and supported.

7.3 RECOMMENDATIONS FOR SPECIFIC RESEARCH FIELDS

SLU research includes basic and applied approaches, and a wide array of natural and social sciences, technology and humanities. The UoAs reviewed were clustered into 15 panels or research fields, which were intended to represent homogeneous, but broad, areas. The Scientific panels in particular, but also to some extent the Stakeholder panels, analysed and drew conclusions regarding collaboration and synergies at various levels of SLU.

This section presents the performance of each research field and suggested improvements. More general and comprehensive recommendations are presented here, such as overlaps and potential synergies between departments, faculties and centres at SLU, and relationships with other universities within and outside Sweden. Some research fields are in need of reinforcement and some organisational steps, such as amalgamation of some units, are judged to be necessary. For more specific comments and suggestions for each UoA, reference is made to the panel reports.

Based on an integrated analysis of the results of the peer review, the fifteen research fields have been grouped into three categories:

Strong	Plant Science; Plant Protection; Ecology and Environmental Sciences; Chemistry, Molecular Biology and Microbiology; Forest Management and Products; Genetics and Breeding
Moderate	Soil and Aquatic Sciences; Animal Health; Landscape Architecture, Urban and Rural Development; Biomedicine; Animal Husbandry; Biosystems Technology; Economics and Statistics; Food Science and Safety
Weaker	Plant Production

This classification takes into account written comments by the panels, not only average scores. The scores should be treated with care, bearing in mind the large variation in performance within some research fields, and given that assessments made by different panels are not fully comparable.

The research fields are described in order according to their overall ranking in the assessment. The figures for number of researchers in each field include those with a PhD degree. The faculties are abbreviated as follows:

LTJ:	Faculty of Landscape Planning, Horticulture and Agricultural Sciences
NL:	Faculty of Natural Resources and Agricultural Science
S:	Faculty of Forest Science
VH:	Faculty of Veterinary Medicine and Animal Science.

Plant Science (13)

The research field consists of 2 units in 2 faculties (NL and S), with 63 researchers.

Although only two units were evaluated in this field, it is of the same size as many of the others in terms of number of scientists. Plant science conducts research on forest genetics and genomics, plant development, physiology and defence mechanisms. Plant science is the outstanding research field at SLU, with high scores on all evaluation criteria. The Experimental Plant Biology and Forest Biotechnology unit (330-1) is considered to have world-leading scientific quality. Relevance and impact is strong, but engagement with the public at all levels can be further developed. As in many other areas, stable long-term funding is important.

Recommendations

The cooperation within SLU and internationally should increase. There is an obvious need for dialogue and collaboration between the forestry/plant science/plant protection research teams, making full use of complementary skills within SLU. The Experimental Plant Biology and Forest Biotechnology unit (330-1) could markedly improve this perception and take the lead in this process. For the Molecular Plant Biology unit (480-1), the establishment of the BioCenter at Ultuna will facilitate interaction and cross-disciplinary approaches to understanding and developing sustainable production of renewable natural resources in the face of biotic and abiotic stressors. Although the field is very strong, increased interaction with other disciplines (eg. ecology, climate modelling, genetics and breeding, and economics) would strengthen the strategic planning and could enhance the quality and broaden the application of the research.

Plant Protection (10)

The research field consists of 10 units in 2 faculties (LTJ and NL), with 92 researchers.

Plant protection at SLU is a wide subject including forest, agricultural and horticultural species and several pathogens and pests, with the emphasis on fungal pathogens and insects. The field includes both basic and applied sciences. Plant protection is thus a profile area at SLU, and generally very strong, with very high scores on all criteria. The most prominent units were Forest Pathology and Mycology (390-3), Plant-Soil-Microorganism Interactions (390-1), and Chemical Ecology (632-1). All of these have world-leading scientific quality, with top scores on three or all four criteria. There are weaker units, particularly in the agricultural field, and it was observed by the panel that there is a "*disconnect between relevance and impact-oriented units and the new bibliometrics of scientific excellence*". It should be noted that basic research related to plant protection is also found in other research fields.

Recommendations

The Plant Protection research field requires that a strategy be developed to balance the development of basic and applied science and extension services. Cooperation should be increased between SLU units studying different Plant Protection topics, including activities related to post-harvest pathology. The combination of increased annual mean temperatures and policy/legislative based restrictions in pesticide use will add to the future importance of this field. The present research and educational capacity in plant pathology at SLU may not match these requirements.

Ecology and Environmental Sciences (3)

The research field consists of 11 units in 3 faculties (NL, S and VH), with 126 researchers.

This is the largest research field evaluated in terms of the number of researchers. It covers a wide range of fields in the ecological sciences, including conservation and population biology, vegetation, landscape and wildlife ecology, ecotoxicology and forest history. The Swedish Biodiversity Centre also belongs to this field. Ecology and Environmental Sciences is one of the strongest research fields at SLU, with high scores in all assessment criteria. The Forest Vegetation Ecology (241-2) and Systems Ecology unit (415-8) received top scores on scientific quality, and the former was also awarded maximum scores on all other evaluation criteria. The panel writes *"SLU hosts one of the most powerful and extensive groups of ecologists in the world"*. However, several of the units located in Uppsala are small and would benefit from closer cooperation to achieve common focus in research and in some cases also stimulate interaction between applied and theoretical approaches.

Recommendations

SLU should further strengthen research in the field of ecology by making strategic recruitments in the field of mathematical modelling, particularly of population dynamics. The Population Biology unit (415-6) might be the appropriate place to accommodate this expertise.

Small units must collaborate more, and in some cases merge to form larger units sharing similar interests. Transversal research programmes on, for instance, global warming and on the effects of climate change on biodiversity could be initiated. Several units at SLU focus on climate change studies and nutrient dynamics, which opens the way for collaboration between departments and faculties. Engagement of economists and social scientists is recommended.

An interesting suggestion from the panel is to combine the National Inventory of Landscapes in Sweden – NILS (260-7) with The Swedish Biodiversity Centre – CBM (910-4). NILS collects and manages data on biodiversity and CBM's mission includes synthesis. A centre of this kind would have an extremely high added value and potential impact, by combining a unit specialising in environmental monitoring with one specialising in biodiversity research planning.

Chemistry, Molecular Biology and Microbiology (15)

The research field consists of 5 units in 1 Faculty (NL), with 67 researchers.

This research field is broad, combining a number of basic research disciplines. The panel concluded: *"All UoAs in this field have a scientific quality above the SLU average."* Research in Chemistry includes characterisation of carbohydrates and of inorganic solutions, and development of nano-structured materials. The emphasis in Molecular Biology is on determination of enzyme structures. The larger Microbiology unit focuses on the ecology, biology, and biotechnical applications of bacteria and fungi. The research field has high scientific quality and high relevance and impact. The most prominent research team was Organic Chemistry/Natural Products Chemistry (450-1). Chemistry is represented by three small units, which would benefit from being merged into one, to create better resilience and impact.

Recommendations

The creation of the BioCenter on the Ultuna campus furthers collaboration between all units in this field, which is encouraged. The strategic planning of how the creation of the BioCenter will best reinforce cooperation and networking between disciplines should start well in advance of the move to the new building.

It is vital that Chemistry will function as a unit in an enlarged *Core Chemistry and Instrument Facility* (CCIF) at the BioCenter, providing synthetic and advanced characterisation services based on its own research under a strong leadership in order to maximise this benefit and international credibility. Inclusion of synthetic chemistry is recommended.

The Molecular Biology Unit (420-1) has a close and synergistic relationship with Uppsala University (UU). This has isolated it from the main SLU campus and overshadowed the UoA's independent identity. Yet the association with the UU team has created critical mass in structural biology which might be lost if the teams were to separate. For SLU to fully benefit from the high research potential of this UoA, the team must be more proactive in initiating links with the new BioCenter on the SLU campus.

The Department of Microbiology should continue to develop fundamental research while maintaining its strong focus on biotechnology.

Forest Management and Products (8)

The research field consists of 12 UoAs in 1 Faculty (S), with 105 researchers.

This core research field at SLU is very broad and consists of both large and small UoAs. It covers a wide range of subjects related to forestry, such as fibre biology, wood technology, silviculture, forest management, operations and techniques, policy issues and forest landscapes. There is a large variation in performance, but the Remote Sensing (260-3), Forest Management (241-1), and Silviculture, Growth and Yield (295-1) units display scientific quality of a high international standard, and Wood Science and Fibre Biology (231-1) is judged to be world leading. As may be expected in a field that covers a broad range of relevant issues in the context of forest management and use, the overall level of relevance and impact is very high. There is considerable overlap and some duplication of research, with a need for coordination of research efforts.

Recommendations

There should be better coordination of research and a proactive attitude by the University to help develop collaboration that can bring about better synergies between research areas. Field trials – new or existing – are unique facilities that need to be better utilised by different research teams. A formal recognition of e.g., Flakaliden as a "long term ecological research site" could be instrumental in promoting collaboration.

One area that would benefit from better coordination is forest planning, where combining methodological and technical experience in one research team with the human-geo-biospheric system approach of another could lead to innovative development. Another example is forest policy research, which is currently fragmented into several units at SLU. In general, policy issues and the social sciences need to be better incorporated in the forest science research agenda.

Many units – particularly small ones – have too broad a research agenda and need to prioritise and focus more. Units are encouraged to broaden international networks and to explore EU funding.

Genetics and Breeding (14)

The research field consists of 6 units in all 4 faculties (LTJ, NL, S and VH), with 65 researchers.

All but one of the units in this research field deal with plants (forest, agricultural and horticultural plants). The field includes basic research in molecular genetics, bioinformatics, resistance

genetics, genetic diversity and plant biotechnology as well as a more applied approach in pre-breeding and other areas related to practical breeding. Taxonomy of cultivated plants is also included. Genetics and breeding is one of the research areas at SLU with the strongest relevance and impact, and this research has international implications. The research field as a whole is weaker in scientific quality; however, there is a significant variation between units and one team – Molecular Genetics and Bioinformatics (670-1) – received top scores on all criteria. Although national collaboration already exists, it can be increased within SLU as well as with industry. It should be noted that some of SLU's research in genetics and breeding was assessed by other panels, i.e. Plant Science and Animal Husbandry.

Recommendations

Research in genetics and breeding is conducted in all faculties. However, distances between campuses and administrative divisions create impediments to networking, cooperation, and communication. Regular meetings of the SLU genetics community are recommended. Strategic planning for replacement of retiring scientists must be improved.

Establishment of bioinformatics expertise in a collaborative fashion between the plant (forest, horticultural and agronomic crops) and the animal genetics units should be a priority. Collaborative genomics projects should be pursued through established cooperation at Uppsala and Stockholm. A centre of research and development for practical plant breeding including pre-breeding efforts should be established. It is essential that universities maintain in-house research capability, to provide high quality training and to carry out high-risk or innovative breeding.

The establishment of taxonomy/phylogeny as a focus area at SLU is strategic, but will require more input. There is a need to develop more collaboration within SLU and beyond in other fields such as evolutionary genetics and population biology.

Horticulture is a profile area at SLU but is fragmented. Concerted efforts are needed to create a greater impact and awareness. It is necessary to incorporate approaches in biochemistry, e.g., in metabolomics, and physiological and genetic analysis concerning product quality and health issues. This can be achieved by cooperative programmes with schools of medicine at, e.g., Lund and Uppsala.

Soil and Aquatic Sciences (12)

The research field consists of 8 UoAs in 2 faculties (NL and S), with 99 researchers.

The Soil and Aquatic sciences field spans a range of topics from aquatic ecology and biodiversity, to soil sciences, plant nutrition, biogeochemistry, biogeophysics, plant-soil interactions and precision agriculture. Many units in this field devote much of their time to Foma activities. The field as a whole is reasonably strong at SLU. The strongest unit is Soil and Plant-Soil Interactions (241-3), which received top scores on three criteria. The panel identified a high degree of fragmentation and a lack of collaboration between soil science units as a very serious problem. SLU is unique in that Foma activities and monitoring are brought into the research sphere. This is excellent, but many units stated that Foma activities are very time consuming, which leaves only limited time for basic research. However, some units are carrying out basic research on the basis of Foma activities and funds.

Recommendations

The faculties need a more flexible structure, and effort is needed to remove barriers so that new research teams can be formed to pursue new issues and topics. There is a clear fragmentation within the Soil and Environment Department. Units within Soil and Aquatic Sciences are strongly urged to increase internal cooperation. A thematic reorganisation might be useful. For example, a number of scientists all study metals – or greenhouse gases – but they are all in different units. To increase the visibility of SLU's research on non-CO_2 emissions from agriculture, collaboration with ongoing research in other parts of SLU is recommended.

There is a need to increase and coordinate international activities, in particular to find ways of sending post-docs and students abroad and to facilitate mid-career sabbaticals. Particularly in the agricultural sciences, units should strive to publish their work in better journals.

The strategies for how to best make use of Foma activities should be developed. Certain activities such as data management and public outreach could benefit from better centralisation. The unique data series produced over many years should be used in tandem with modelling and synthesis.

Animal Health (5)

The research field consists of 12 UoAs, all in the VH Faculty, with 77 researchers.

This field, which is unique to SLU in Sweden, provides a breadth of research expertise in subjects such as medicine, hygiene, physiology, surgery and animal reproduction. It also includes a number of topics related to pest and diseases such as epidemiology, virology, bacteriology and parasitology. Although world-leading teams were lacking, this field received the highest average score – for scientific quality and overall – of the three fields making up veterinary medicine and animal sciences. The highest scoring units were Small Animal Medicine (715-7), Reproduction (715-11) and Virology (713-7). This research field is dominated by small research teams lacking critical mass and a need for succession of senior staff, so scores on strategy and potential were relatively low. Involvement in diagnostics, epidemiology, pathogenesis and eradication of infectious diseases, particularly in food animals, is an area of strength, but coordinated efforts are lacking. Some overlaps between UoAs exist and there is little collaboration between them. Uncertainty coupled to reorganisation (creation of the animal hospital, altered relationship with SVA – the National Veterinary Institute) is another cause for concern.

Recommendations

The forms for collaboration with the University Animal Hospital need to be clarified. The evaluation panel states that *"…access to patients for research and teaching seems to be insufficient, to the point where maintenance of relevant clinical skills is endangered*", and suggests creation of joint appointments between the Faculty and the hospital as one solution.

Another challenge is to maintain the successful collaboration with SVA in bacteriology, virology and parasitology if physical separation takes place. Continuous access to scientific staff, and laboratory and animal facilities with the highest biosecurity standards that allow work with highly infectious agents, is mandatory for these research areas.

The Ruminant Medicine unit (715-5) would benefit from closer collaboration with the Animal Hygiene (880-2) unit in Skara, where large amounts of field material would be available.

The organisational structure should be revised to reduce overlaps and form more effective configurations. Increased collaboration or communication with the Centre for Bioinformatics might strengthen the work of several teams. A joint research programme on infectious diseases involving several UoAs and with a common methodological ("omics") platform is recommended.

Landscape Architecture, Urban and Rural Development (2)

The research field consists of 14 UoAs in 3 faculties (LTJ, NL and S), with 87 researchers.

Research in this field is highly diverse and constitutes a profile area for SLU. It includes research on the varied relationships between society and environment, and the relationship between people, space and place, as well as the spectrum from past to present and future. Despite showing a great diversity of disciplines, the units focus particularly on the humanities and the social sciences. As a whole, the field received a moderate score for Scientific Quality but with a large spread. Similar variation is found for the other assessment criteria. The highest scoring units were Environmental Communication (595-3), Rural Development (595-1) and Environmental Psy-

chology (638-3). Although interdisciplinarity and globalisation is present, the field is fragmented at present. The panel saw potential for international leadership in Rural Development at SLU.

Recommendations

SLU has the capacity to take the national and international lead in the development of agri-environmental policies due to its blend of natural and social science expertise, coupled with real links with stakeholders in the food and farming industry. One model would be to bring all research on sustainable food and farming systems into an expanded agroecology grouping and to separate out the knowledge transfer and exchange remit into a revitalised CUL. Organic farming could be used as one of many possible model systems for sustainable agriculture.

Strong interdisciplinary links between the natural and social sciences and the humanities should be established to create a better sense of involvement for researchers in this field at the natural science-dominated SLU.

Landscape architecture and landscape planning are fragmented in different faculties, departments, and at different geographical locations. There is considerable overlap between units, and researchers with similar interests and projects are not working together, resulting in a lack of an overall research strategy. It is obvious that research leadership is lacking. SLU should initiate a collaborative process to define research directions and focal points. It is recommended that a stronger, internationally recognised and more inclusive framework be created by the establishment of a university-wide "*Centre for Landscape Architecture and Planning Research" (CLAR*), enabling departments at Alnarp and Uppsala to complement each other. Merging the smaller research teams would result in one of the largest research centres of its kind in Europe. This offers the potential to develop excellence in research on user involvement and human dimensions of designed landscapes.

The University should revive *the Garden, Park and Landscape Research Network* (TPL), established in 2000. This connecting mechanism is vital to support the university-wide, multi-disciplinary nature of landscape history and heritage and maximise the University's role in implementing the European Landscape Convention.

SLU should consider establishing a *Nordic Competence and Learning Centre* in the field of work science focusing on rural health and safety in agriculture, which could develop general international cooperation. One move should be to include social sciences from outside SLU in order to strengthen social science skills in this important field.

Biomedicine (7)

The field consists of 5 UoAs, all in the VH Faculty, with 37 researchers.

This research field covers important basic subjects on the veterinary curriculum, such as pathology, biochemistry, pharmacology, toxicology and immunology. It is the second smallest field in terms of number of researchers, with small to medium-sized research teams. This field falls in the middle range for most assessment criteria. The most prominent UoA is Medical Biochemistry (712-1). Although potential is clearly present, UoAs had apparently been clustered for the purpose of KoN and some lack a clear vision and a detailed strategy for future development. In some cases there is also uncertainty about appointments of new professors. In individual units there is limited coherence between research lines, and cooperation between departments and units is also limited.

Recommendations

Greater depth of transdisciplinary collaboration in the field of Biomedicine is suggested. Natural links between disciplines within this field, as well as with related fields within the Faculty, e.g., infectious diseases and clinical reproduction, should be explored. The units are urged to develop

strategies with clear, common objectives, and detailed plans for creating the funding and recruitment necessary to achieve these objectives. Strategic programmes involving different research teams would facilitate transdisciplinary and transdepartmental collaboration and help achieve critical mass without structural reorganisation.

Incentives to initiate the involvement of biochemists in veterinary research are suggested. This could lead to a *Centre of Excellence in Molecular Veterinary Sciences*. Technical facilities such as virtual conference rooms allowing joint seminars, joint lab meetings and even joint data assessments can stimulate this interaction.

In addition to improved collaboration within SLU, cooperation with Uppsala University and the Medical Products Agency, as well as international networks, should be maintained and strengthened.

Animal Husbandry (6)

The field consists of 11 UoAs, in 3 faculties (NL, S and VH), with 76 researchers.

This field is very broad, covering disciplines as diverse as genetics, ethology, nutrition, feed science, and production systems and species as diverse as reindeer, pigs and fish. It is one of the traditional key agricultural disciplines and unique to SLU in Sweden. As a whole, the field lies in the moderate range in the assessment, and the predominantly moderate to low scores on scientific quality are a cause for concern. However, the Quantitative Genetics and Animal Breeding (670-2), and Ethology and Animal Welfare (880-1) units are of a high international standard. The breadth and diversity of the field is a strength that is not currently being fully exploited, and there are many overlaps, particularly in research on ruminants. Modern technologies are not being utilised to the full and links with Food Science are, with exceptions such as Aquaculture, not well developed.

Recommendations

To diminish overlaps and fully exploit the potential synergies of this diverse research field, work must be focused and coordinated. Closer interaction with Food Science is essential. Work in developing countries must be better coordinated and managed. New "omics" techniques, including nutrigenomics, should be exploited.

There is great potential for improving productivity and developing high quality international research in aquaculture at SLU. Research is performed in different faculties. This could be solved by creating a *Centre of Excellence in Aquaculture,* including all researchers involved. This structure would do much to achieve critical mass without physically moving staff, as well as better coordination of research priorities.

There is a clear overlap of activity between Ruminants, Nutrition (650-2), Ruminants, Management (650-3) and Feed Science (650-5). These are small units, and there is a case for combining them in a single unit to provide a more integrated approach with critical mass.

There should be increased cooperation between research teams conducting basic research on poultry physiology, ethology and veterinary problems. The synergies thus created will improve not only utilisation of the new research facilities, but also the quality of publications.

There may be a case for creating a *core Feed Science research team*, interacting with research on all species. This focus would generate a critical mass of expertise, allowing interaction between those with interests in different species.

The concept of creating an *International Centre of Excellence in Farm Animal Lactation* is an interesting prospect, including the whole system approach and aspects of cow traffic management. The Animal Husbandry panel considered there to be a great deal of overlap in ruminant research between units. The establishment of a centre might be a solution to this problem.

Based on the Ethology and Animal Welfare unit (880-1) and with broad collaboration, the creation of a *Behaviour and Welfare Centre of Excellence* should be formalised.

It is recommended that research on reindeer husbandry be strengthened. Collaboration and complementary use of expertise between the different Nordic institutions are definitely needed.

Biosystems Technology (9)

The research field consists of 9 UoAs in 2 faculties (LTJ and NL), with 74 researchers.

Biosystems technology is an important area for SLU with regard to sustainable agriculture and land use. It covers a broad scientific field, including soil and water management, biomass technology, bioenergy, farming systems, rural building design and climate and energy technology. The field ranks among the lower fields in the "moderate" group. The stronger research teams are Biomass Engineering and Technology (54-1), and Soil and Water Management (435-2). Leadership issues are deemed to be particularly important for this field, as are enhanced internal strategic cooperation, clarification of names of units, as well as increased stakeholder cooperation. Several of the units are seen as being too small to maintain long-term vitality.

Recommendations

Technology-related research is generally weak at SLU and strategic alliances with other universities are clearly required, both in research and in teaching of Biosystems technology. Increased inter-faculty and transdepartmental synergies should be sought to improve the whole area, which is better described as "Biosystems Engineering". Consideration must be given to how to formulate the most effective teams. The range of UoA titles must be simplified and clarified. It is recommended that SLU organise multi-disciplinary conferences involving the various units in order to identify greater synergies within their work.

It would be highly desirable to establish an international *Bio-refinery Research School* in cooperation with industry and stakeholders, and in collaboration with the ongoing research school in Bioenergy at the NL Faculty. This would be of value for both the forest and agricultural sectors. SLU should encourage exchange of information between research and industry in the biorefinery area in order to improve the use of forestry products.

It is recommended that SLU organise multi-disciplinary conferences to identify greater synergies with towns and communities interested in urban green spaces and in landscape planning.

Economics and Statistics (1)

The research field consists of 12 UoAs in 3 faculties (LTJ, NL and S), with 66 researchers.

The field is broad and covers forest, agricultural and horticultural economics, environmental economics, biometry and statistics. The team researching in Agrarian History and Economic History (510-1) was also assessed in this field. The average scientific quality of the field is rather weak, but there is a wide variation between units. The Biostochastics (300-1) and Resource and Environmental Economics units (300-2) perform strongly. Economics and Statistics is a field with high relevance and impact, as witnessed by many high scores. Strategic planning, coordination of research as well as coordination of research and teaching must be improved in several disciplines. Although some disciplines have good international networks, the field in general can be strengthened by increased cooperation within SLU and internationally.

Recommendations

Powerful actions are recommended to develop a SLU strategy for research in all areas of economics (Business Administration, Applied economics and Environment & Resource economics). Reduction of overlaps and development of synergies between units, departments and faculties should be included. Action should be taken to strengthen disciplines with high relevance and impact, but low scientific quality.

One important area where collaboration could be fruitful is economy of rural based enterprises, including small scale processing, diversity in products and services, etc. Research with "the whole supply chain management" approach (food, forestry, etc.), including process industry and consumers, should be considered, as well as collaboration with product and production sciences in food and forestry.

Natural resource economics in Alnarp, together with landscape architecture and environmental psychology, should take advantage of their location in southern Sweden and work more closely with their counterparts at the universities of Copenhagen and Lund. Natural resource economics teams in Uppsala and Umeå are recommended to pursue Foma activities.

The fields of statistics and biostochastics are important for the whole University, particularly the development and application of statistical methods, such as environmental monitoring, econometric models, growth models, remote sensing and others. There should be greater coordination of statistical research and modelling, teaching programmes and statistical consulting at all levels of SLU. Statistical expertise must be available at all major SLU campus locations. A single organisational unit, the *Centre of Biostochastics and Statistics*, should be created, with the Biostochastics unit (300-1) as the core, and also including Biometry and Systems Analysis (565-2) and Applied Statistics (566-1). A *European Centre for Biostochastics* could be established, which could become a leading research centre in the field.

Food Science and Safety (4)

The research field consists of 3 UoAs from 2 faculties (NL and VH), with 33 researchers.

Food Science and Safety is clearly an important profile area at SLU. In KoN, research on food science, food safety, toxicology and microbiology were assessed by this panel, but there is also research related to food science at SLU assessed by other panels. This field is presently one of the weaker ones at the University overall. However, the field is ranked among the best for Scientific Quality. The strongest unit was the largest, i.e. Food Science (550-1), particularly research on plant products. The present strong veterinary and public health focus in the other two units assessed may be a constraint on synergies within the food processing safety area. All three units are involved in teaching Food Science majors and Veterinary students, both of whom are much in demand in the job market. The comparatively low scores for Relevance and Impact ("moderate") are thus somewhat surprising. None of the units was perceived as utilising the existing potential for synergies within SLU.

Recommendations

SLU's entire research on food-related issues should be reviewed in order to strengthen the field and increase its visibility. There is a clear need to develop a strategy for coordination and cooperation. An alternative internal structure in which disciplines (e.g., biochemistry, nutrition, microbiology, genetics) form the basis, will improve scientific strength, increase flexibility and make recruitment easier.

There should be expanding research in the biosciences on the role of food and bioactives in nutrition and human health, including both beneficial and toxicological aspects. The food for health research area, including food safety issues such as bioactive compounds in foods, is another area of importance for SLU. Closer cooperation with the Department of Microbiology is essential for development of the food safety field.

Enhanced interaction with the genetic sciences (plant breeding, animal breeding) would provide increased research potential, "Farm to Fork" approaches, e.g., under the Future Agriculture programme currently being planned at SLU, as well as within industrial European Food for Life initiatives. Innovative "omics" techniques should be included as research tools to facilitate better mechanistic understanding.

The Stakeholder panel would like to see a more holistic view, in which research and education are performed at a system level, for example, "the farm" (a system under which food and energy are produced in parallel) or in value chains (from production via processes to the consumer). Research and education on food require consideration of the entire food chain, linking research with industry.

Plant Production (11)

This research field consists of 9 UoAs in 2 faculties (LTJ and NL), with 51 researchers.

Plant Production should be a strong, dedicated profile area at an agricultural university, comparable with Medicine at a Medical faculty, but it is presently the weakest research field at SLU. The field includes crop physiology, weed biology, crop science, horticultural production and production quality. Scores were moderate to low on most criteria, and only one unit – Horticultural Production Quality and Postharvest (633-2) – received scores over 4. The low scores for Plant Production, in particular for Strategy and Potential, is a strong signal to units, departments and faculties at SLU that a change is needed. Stakeholder representatives expected research to be conducted on economically important crops in Sweden so that education programmes at SLU would be able to provide expertise ready to meet future agricultural conditions.

Recommendations

The Plant Production field must create research environments combining basic and applied research, and be able to develop plant production systems with maximum harvests and minimum input of energy and chemicals, thus providing minimal environmental disturbance. Future increased and competing demands for land for Food, Feeds, Fibre and Fuels will require a dramatic increase in productivity from sustainable plant production systems. Climate change provides additional challenges. The cropping system cannot be seen in isolation from the farming system, and effective networking with several units is therefore encouraged. This includes cooperating with other disciplines, e.g., Soil Science, Plant Breeding and Biosystems Technology, and integrating modelling techniques and systems analysis methodology.

A number of units have similar interests and scope over faculty borders and could be more effective, particularly in achieving world recognition, if they had more integrative and synergistic collaboration and combined strategic management. The UoAs should coalesce around clear visions, common goals, research themes, and ultimately well articulated strategies. This was particularly stressed by stakeholder representatives.

7.4 RECOMMENDATIONS FOR ENVIRONMENTAL MONITORING AND ASSESSMENT (Foma)

The Stakeholder panel concluded that, overall, Foma is well organised and provides essential information for sustainable management of natural resources in Sweden. The Scientific panels praised Foma as a unique asset for SLU and underlined the advantage of combining Foma with research "under the same roof". Both panel categories made a number of comments aimed at improving the efficiency and utility of Foma operations. The following list of recommendations is based on an integrated analysis of these comments.

Recommendations

Mission and international scope

Foma's mission should be reformulated so that it is better understood both within the University and by external stakeholders. The mission should be further defined in operational goals at SLU level and for each programme. A clearer strategy is needed on how to assess environmental problems and draw the line between presenting results and forming opinions based on the results.

The requirements for monitoring activities under EU agreements are currently increasing, and it is important for SLU to be more actively involved in international cooperation in this context. In many cases, Foma should broaden its scope, from a sometimes rather strict focus on the Swedish Environmental Quality Objectives, to include more international collaboration and the need for decision support information in the agricultural sectors.

Funding strategies

The long-term funding of the expanded Foma operations that started 2006 is not secure. In addition, both panels and UoAs have identified several interesting potential new Foma activities. SLU should develop strategies for managing this situation in close collaboration with its stakeholders.

Career paths

The incentives for SLU staff to work with Foma should be improved. The current tenure track system is an obstacle to employing and keeping qualified people in positions designed for Foma activities. A strategy should be developed for the supply of specialist skills, e.g., statisticians, communication officers and GIS analysts.

Interaction between Foma and research

One issue of central importance to SLU's Foma operations is to achieve better interaction between Foma and research. Foma units, as well as faculties and SLU centrally, must develop a strategy for how to best make use of Foma activities and the unique data they generate. In particular, modelling know-how elsewhere at SLU could be a powerful tool for Foma, and also for interdisciplinary collaboration with economists and social scientists.

Career positions that include a combined mission in research and Foma are another measure that can improve integration between the two operations.

Interaction with stakeholders

Although active interaction with stakeholders is already a feature of Foma, collaboration with stakeholders, as well as collaboration within SLU, could be improved. Stakeholder interaction could be improved by establishing a strategic reference group in addition to those reference groups that are linked to the different programmes. SLU should consider how public outreach of Foma in general could benefit from centralisation and coordination.

Currently, the fairly large number of Foma programmes appears to be an obstacle to increased internal and external collaboration. SLU should evaluate the scope for merging some of the current programmes. Strategic thinking is proposed in relation to external partners, with a view to obtaining mutual benefit from additional know-how.

Increased visibility and utilisation

Foma's visibility should be enhanced. Means of achieving this include activities ranging from improved presentation of Foma activities and results on the web to new types of outreach activities such as citizen science projects. Added value can be created if alternative solutions are de-

scribed and their impact analysed and presented. The emphasis should more often be placed on producing well-balanced reports on which to base decisions, e.g., a balance between effects on biodiversity and yield.

The need for increasing data availability is stressed by both Scientific and Stakeholder panels. Data must be accessible using modern means, internally and externally, for analyses, research and follow-up. This requirement has already been recognised by SLU and support from data platform staff is being established for the primary purpose of assessing Foma data management procedures and secure data quality. Foma data must be reliable and easy to use.

8 SYNTHESIS

8.1 GLOBAL CHALLENGES AND NATIONAL NEEDS

The combined burden of climate change, and a global population growing by 50% to more than nine billion people in 2050, places enormous pressure on global ecosystems (FAO 2009). Population growth, combined with changing consumption patterns in developing countries, will require 70% more food by 2050 (FAO 2009). Competition for land and water resources for production of food, feed, fibres and fuels is thus likely to escalate. Temperature changes will influence the general functioning of ecosystems, change species composition and will exacerbate problems caused by insects, fungi and other pathogens in agriculture and forestry, jeopardising development of sustainable systems. A warmer climate, coupled with increasing herd sizes and the crowding of animal husbandry systems, is likely to increase zoonoses and pandemics. In short, there is a great danger of the world's agricultural and forestry systems becoming much less sustainable. Global urbanisation has already led to urban sprawl and outright slums, where the quality of life is at best sub-optimal and frequently very poor.

While the present Swedish environmental situation and general living conditions are far better than those in most other countries, national needs and challenges are certainly present. Loss of nutrients from agricultural soils, leading to Baltic Sea eutrophication, insufficient economic sustainability of farming systems, conflicts in forest use, loss of biodiversity, wasteful food handling, zoonoses, conflicts in rural land use between city-dwellers and forestry/agriculture, underdeveloped aquaculture, urban sprawl and loss of agricultural soils and are but a few examples. Global changes, combined with overpopulation, will probably lead to waves of climate migrants/refugees to northern countries. Temperate ecosystems are likely to change in unpredictable ways, affecting biological production and the overall economy of the green sector.

Both global challenges and national needs underscore the importance of intensified research in agriculture, forestry and veterinary sciences, and in urban and rural planning. In order to realise the potential for scientific development in these disciplines, needs-driven basic and applied research must be underpinned by, and interact with, solid fundamental research in natural and social sciences.

8.2 SLU RESPONSES TO CHALLENGES AND NEEDS

The Swedish University of Agricultural Sciences strives to provide a scientific base that can help to mitigate some of these needs and problems. To this end, the university has recently adopted new Mission and Vision statements:

Mission

SLU develops the understanding and sustainable use and management of biological natural resources.

This is achieved by research, education and environmental monitoring and assessment, in collaboration with the surrounding community.

Vision

SLU is a world-class university in the fields of life- and environmental sciences.

The KoN evaluation provides an assessment of whether the scientific community and representative stakeholders see the mission as "accomplished" and the vision as being fulfilled/achieved. The general conclusion is that SLU has many research units of high scientific quality, some being at the absolute forefront of global research. The higher quality units are generally found in the fields of more fundamental science. While many units in applied fields of research are of reasonable quality, certain SLU profile areas require attention to improve both scientific quality and the value provided for stakeholders and society at large. In addition, fragmentation of research into too many small units, with limited long-term potential and lacking strategic thinking and planning also contributes to suboptimal visibility and image.

Based on these observations the KoN Management Team proposes creating four interdisciplinary research areas, combining the strengths of all four faculties.

8.3 FOUR RESEARCH AREAS FOR THE FUTURE – PROPOSED ACTION

The creation of the following four broad research areas is proposed, providing an opportunity for all SLU research units to find a place within a larger scientific framework:

Future Forests, Future Agriculture, Future Animal Health and Welfare, and Man in the Future Environment

The proposed four areas are platforms that integrate research programmes and other activities, e.g., outreach, extension and education. Activities have already started in Future Forest and Future Agriculture, and these will be central components of the proposed research areas with the same names. The four research areas can constitute platforms for a number of joint activities such as internal interaction and coordination of research projects, formulation of major grant proposals, interdisciplinary specialist seminars, as well as serving as arenas for comprehensive and forward-looking discussions. They will constitute power bases enabling SLU to adopt a strong role as coordinator for national and international research programmes and in formulating new strategies for future development. The four areas will also be important entry points in communicating SLU research to society at large, e.g., by linking collaborating scientific disciplines under a common web portal. The importance of creating entry points of this kind was emphasised in the Impact and Utility evaluation, as well as in other stakeholder surveys, e.g., the assessment of *Partnerskap Alnarp* (Schroeder 2008).

The organisation of SLU in faculties and departments provides the necessary academic disciplinary structure, while the *Four Research Areas for the Future* will constitute a dynamic matrix organisation. It should be noted that their creation does not involve major changes in the existing University organisation. While the four areas will welcome inclusion of all research activities, it

is important to stress that participation is voluntary. Area activities can be coordinated and communicated by four small secretariats, in close cooperation with SLU information office staff and faculty scientific officers. It is recommended that SLU provide seed money to enhance the prospects of success of new initiatives in the four research areas. Foma activities can be included in all areas. The four research areas proposed all comprise research units from at least three of the four faculties, and they include natural and social sciences as well as disciplinary and interdisciplinary research.

The *Four Future Areas* are described briefly below. A feature common to all of them is that they will serve as "docking stations" and frameworks for new and existing research programmes.

Future Forests

The functioning of forest ecosystems holds the key to a sustainable future, i.e. through carbon sequestration. The economic and recreational value of forest systems cannot be overstated. Their direct economic impact is particularly important for Sweden, but increasing demand and competition for biomass for fibre and fuels, whilst still maintaining other ecosystem services, is a global dilemma. A large research programme started early in 2009 with funding from Mistra, the forest industry and SLU, and involves two of the faculties in joint research activities. It also includes the University of Umeå and Skogforsk. The KoN proposal aims to broaden and strengthen this initiative, and it is expected that strong research collaboration will be forged with both *Future Agriculture* and *Man in the Future Environment*.

Future Agriculture

The development of sustainable systems to manage agricultural production is crucial for the future of humankind. The global demand for food for more than 3 billion new inhabitants is a real challenge, involving issues of both food security and safety. In addition, agriculture must reduce energy consumption and its environmental footprint, while also providing large amounts of bioenergy. The growing demand for other kinds of land use, such as recreation and building, increases the risk of conflicts. Agriculture of the future will face many ethical issues. A major research programme, involving three SLU faculties, started in autumn 2009, with scenario building, stakeholder seminars etc., focusing on issues related to animals, plants and soils. Postdocs are currently being recruited. The broader research area proposed here would host many types of research relating to agriculture and food production from farm to fork. It would include food safety and quality issues, such as health issues and food functionality closely related to *Future Animal Health and Welfare* research. There are clear links with the areas involved in *Future Forests* and *Man in the Future Environment*.

Future Animal Health and Welfare

In the farming situation, animal welfare considerations must be integrated into a sound production economy. Globally transmitted diseases and global changes in consumption patterns create challenges for breeding and husbandry systems, as well as disease control. The growing number of companion animals and animals kept for recreation and sport places increasing demands on veterinary health care. The need to better understand animal-human interaction and the importance of animals for human wellbeing will increase in the future. Rapid technical and theoretical developments in systems biology, including understanding animals as models for human diseases, offer interesting potential for research in veterinary medicine and thus for improving animal and human health. This new area will build on existing strengths and integrate research on medical, ethological, ethical, and economic aspects, as well as fundamental natural sciences, and involves units from three of the faculties. The start-up phase will include scenario building, stakeholder seminars etc. and building strong links to both *Future Agriculture* and *Man in the Future Environment*.

Man in the Future Environment

Globally, a growing majority of humans will live in cities or in suburban areas. Conflicts over land use are likely to increase in the future. The planning and organisation of energy-efficient urban areas so as to spare land resources useful for food and fibre production, while still improving the quality of human life and a sustainable environment, is a daunting task. SLU has unique opportunities to combine research expertise in different disciplines to achieve this goal. Research in the field of landscape architecture, landscape planning and urban and rural development may thus develop joint and focused thematic programmes in this area. Other social sciences and natural sciences should be included. Systems analytical approaches will be particularly useful in studying flows of energy, materials, capital and humans in different situations. The start-up phase will include scenario building, stakeholder seminars etc. There is enormous scope for interaction with all the other three Future Research Areas.

8.4 IMPLICATIONS FOR SLU

Successful implementation of the framework described above will/may:

- provide advanced platforms for continuous analysis of national and global trends
- enable SLU to efficiently contribute to meeting global challenges and national needs
- make SLU activities more visible to stakeholders and society at large
- enhance SLU's image
- strengthen SLU's internal identity
- make SLU education programmes more attractive to students
- develop horizontal and interdisciplinary science from strong disciplinary bases
- improve links between fundamental and applied research
- better integrate Foma activities in research
- strengthen internal and external cooperation
- provide syntheses of research of vital importance to society
- improve SLU funding competiveness, particularly in international research applications and major national strategic programmes

The KoN Management Team firmly believes that the creation of *Four Research Areas for the Future* will strengthen research and education at SLU and improve the utility and impact of SLU's activities in society, nationally as well as in the international arena.

9 IMPLEMENTATION

There are extraordinarily high expectations internally at SLU and among interested stakeholders and organisations outside the University that the results of KoN will lead to visible changes in the near and the long term. The Scientific and the Stakeholder panels (including interviewees) all expressed a great interest in knowing what SLU intends to do – or not do – in response to the proposals and recommendations made. One Stakeholder panel pointed out the potential obstacle to increasing impact and utility if SLU, for various reasons, fails to "*implement necessary changes that are called for as a result of KoN*". The issues for implementation include internal aspects such as qualification systems, funding models and recruitment policy.

A substantial amount of time and resources have been invested in the KoN evaluation project. Many people have been involved, not least researchers and other staff at the University, and so swift and decisive action is called for. At the same time, the recommendations and other suggestions must be implemented with great care. This report includes a considerable number of suggestions and recommendations. Some are urgent and others need consideration and planning and may thus take somewhat longer to accomplish. However, there are some obvious results of KoN that can be promptly implemented, such as rewarding successful, excellent UoAs.

9.1 IMPLEMENTATION AT VARIOUS LEVELS OF SLU

All levels of organisation at SLU have been deeply involved in the KoN evaluation, and all levels should also be involved in implementing the outcome. Even if the identification of the individual UoAs in KoN was not absolutely ideal, it largely served its purpose in allowing appraisal of scientific quality at a level of detail that would not have been possible at departmental level.

Units of Assessment

Although the task of writing a self-assessment was seen as a burden at the outset, many UoAs have said that the process was rewarding in itself. Comments such as "*this was the first time we actually sat down together to discuss a common strategy*" speak for themselves. This requirement undoubtedly created a greater awareness among researchers of the importance and benefit of recurring examination of objectives, means and values. For the future it is important that each defined research team continues to pursue strategic development. The specific comments made by the evaluators, as well as recommendations in this report (Chapters 4.4 and 7) can be used to further develop individual strategies.

Departments

At departmental level, it is obvious that the small and informal groupings that do not actually function as research teams should be carefully examined. The panel recommendations were quite clear: SLU has a fragmented and loose structure and is made up of far too many, too small and too indistinct research teams. This problem should mainly be considered at departmental level. In cases where there are activities in the same research field in different departments or different

faculties, coordination across organisational borders will be required. It seems necessary to have a very open attitude when discussing synergies and overlaps between various entities (research teams, departments and faculties).

Faculty and University

A large number of KoN recommendations have been put forward that will require consideration at faculty and university level. These include questions of leadership, comprehensive strategic planning, communication, etc. From the impact and utility point of view, the proposals for deeper and more continuous dialogue are vital. The recommendations concerning extension services and scientific focus seem particularly important to accomplish.

9.2 SLU'S STRATEGIC PLAN AND THE FOUR RESEARCH PLATFORMS

SLU recently developed a strategic plan for the years 2009 – 2012 (Knowledge for a Sustainable Future; SLU 2008). This is a comprehensive "self-assessment" at university level designed to examine future challenges. The plan addresses a number of issues also addressed by KoN, which shows that SLU is aware of some of the prerequisites for favourable development, such as globalisation, collaboration with other universities, quality improvements, and infrastructure development. The KoN recommendations will be a valuable support in implementing the strategic plan.

SLU's strategic plan sets out the University's planned strategic areas, which are:

- Climate and ecosystem change
- Scope for reduction of greenhouse gases
- Genetic resources and biotechnology
- Animal health and animal welfare
- Natural resource management
- Rural areas, agro-industry and industrial development
- Landscape architecture

These should partly be seen as development of strong disciplines within larger research areas. In future strategic development at SLU, these (and other) strategic areas should be further expounded to form the cornerstones of the four major research platforms suggested in Chapter 8, namely:

- Future Forests
- Future Agriculture
- Future Animal Health and Welfare
- Man in the Future Environment

For the implementation of KoN and further development, it is vital that SLU seek to incorporate the recommendations by the panels of more research focus and less fragmentation in its long-term strategic scientific planning. Here, the proposed "think tanks" at various levels can be valuable tools.

9.3 COMMUNICATION OF CHANGES

It is essential for SLU that the changes implemented on the basis of the KoN recommendations are clear and visible to the surrounding society. This is particularly important so that SLU communicates that it is adopting greater responsibility for research into major production and environmental issues for the future, such as climate change, food security in relation to population growth, health, sustainable production, global urbanisation and use of land and aquatic ecosystems, etc. It should be made much more evident that SLU is an organisation with a deep insight into national and global problems and is determined to rise to the challenge and contribute to solutions (not only focus on the problems). Without giving up its academic freedom of opinion, it should be made much clearer what know-how SLU possesses and which issues need further intensive research. Action in this area will influence and improve SLU's image, which has been questioned.

9.4 ORGANISATION VERSUS OPERATION

The primary task of the KoN evaluation was to mirror and analyse scientific quality, as well as the impact and utility of research. The panels considered these the key issues, but most panels could not completely separate operation from organisation: these aspects influence each other. Since a number of under-exploited synergies, overlaps and duplications were noted, it is logical to analyse the reason for weaker performance in some UoAs or research fields and to consider possible solutions to these obvious problems. One way of dealing with problems of this kind is to carry out various types of reorganisation. With a few exceptions, the KoN Management Team chose not to give specific recommendations on organisational matters, since this was not included in its remit. Even though organisational changes as such should not be the main result of the KoN evaluation, it is appropriate for SLU to consider the suggestions, which, for example, include the creation of virtual (not physical) centres of excellence, all of which are intended to improve scientific quality and impact.

9.5 SLU'S INTERNAL SYSTEMS AND OPERATIONAL DATA

A major shortcoming of KoN is that much of the operational information on staff, funding and publications provided to the Scientific panels was incorrect. It was decided to use data in central administrative systems, but the inherent technical problems (mainly due to the use of a UoA concept not included in the systems), and the time needed to cope with them, were underestimated.

For future evaluations – and for recurring follow-up of performance – access to high quality publication data is imperative, and resources should be allocated to that end. SLU must develop a comprehensive bibliographic database of the standard required for bibliometric analysis of scientific publications. The database should also cover other types of publications that are important for outreach purposes, e.g., reports and popular articles.

Various operational data, including publication data, are a basis for funding allocation, both from central government to the Universitiy and from the University to departments and other entities. It is thus vital for SLU to develop its operational systems to meet the standards required to produce correct estimates for funding allocation purposes.

9.6 FUTURE EVALUATIONS

A number of interested and dedicated individuals external to SLU have been involved in the KoN evaluation in the Scientific panels as well as the Stakeholder panels and as interviewees. They have presented a thorough and penetrative analysis of the present situation at SLU and have put forward a number of valuable suggestions and recommendations. The evaluation has been fair and has resulted in positive and negative comments presented to SLU management for implementation and consideration of what is feasible. KoN has given SLU an excellent tool for future development and to use as a basis for planning future follow-up. Notwithstanding some problems in the course of the process, the KoN evaluation as a whole must be considered to have been highly successful.

In evaluating the KoN process *per se*, it is vital that SLU consider and plan when and how future evaluations should be made. A reasonable time span between major evaluations ought to be four or five years, naturally accompanied by annual updating of strategic goals and investments. It would be reasonable for SLU to make a study of the implementation of the present KoN evaluation in two to three years' time to see what action has been taken and what remains to be accomplished (and which of the KoN recommendations have become obsolete). This would give the University an indication of the procedure to be followed in a forthcoming major evaluation ("the next KoN").

Based on the experience gained from the completed KoN project, it should be possible to avoid major snags in a future evaluation (at least those that have occurred in the present KoN). The KoN Management Team gives the following recommendations (to be elaborated in an internal report):

- Better operational data must be available
- The publication database must be improved
- The UoA concept should reflect actual and more coherent organisational groupings
- The "brain power" concept should be avoided
- An efficient organisation and sufficient staff resources must be available for the evaluation
- Internal communication must be improved
- Sufficient time must be allotted for the planning phase

Some of the very positive and more successful parts of KoN were:

- Well-planned and executed logistics during the visits by the evaluation panels
- The inclusion of stakeholder representatives in the Scientific panels
- The whole assessment of Quality and Impact, both the interviews and the Stakeholder panels, created particular interest in society and among stakeholders
- Despite the problems, SLU was evaluated thoroughly at individual research team level (UoAs)
- The self-assessments, as they were interpreted by most UoAs, created an increased awareness of strategic issues

KoN was the first comprehensive evaluation of the University since 1991. It has been a positive experience for most of those involved. Now it is up to SLU to take steps to implement the recommendations.

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APPENDICES

Appendix 1 Scientific panels

1. Economics and Statistics

Chairperson

Prof. Anne Toppinen	University of Helsinki, Finland

Panel member – Scientists

Prof. Dr. agr.habil. Dr. rer.hort. Wolfgang Lentz	Hochschule für Technik und Wirtschaft Dresden, Germany
Prof. Jill McCluskey	Washington State University, USA
Prof. Dr. Dr. h.c. Dieter Pelz	University of Freiburg, Germany

Panel member – Stakeholders

Dr. Bo Andersson	Swedbank
Dr. Alex Teterukovsky	If

2. Landscape Architecture, Urban and Rural Development

Chairperson

Prof. Malene Hauxner	University of Copenhagen, Denmark

Panel member – Scientists

Prof. Erland Eklund	Åbo Akademi University, Finland
Prof. Mark Francis	University of California, USA
Prof. Susan Senecah	State University of New York, USA
Prof. Carys Swanwick	The University of Sheffield, UK
Prof. Catharine Ward Thompson	Edinburgh College of Art, UK
Dr. Christine Watson	Scottish Agricultural College, UK

Panel member- Stakeholders

Dr. Anders Modig	Sweco AB

3. Ecology and Environmental Sciences

Chairperson

Prof. Mark Boyce	University of Alberta, Canada

Panel member – Scientists

Prof. Michel Baguette	Muséum National d'Histoire Naturelle, France
Prof. Ian Fleming	Memorial University of Newfoundland, Canada
Prof. Mary Scholes	University of Witwatersrand, South Africa
Prof. Helmut Segner	University of Bern, Switzerland
Prof. Martin Hermy	Katholieke Universitet Leuven, Belgium

Panel member- Stakeholders

Dr. Ola Jennersten	WWW – World Wide Fund for Nature
Dr. Johan Wallander	Swedish Board of Agriculture

4. Food Science and Safety

Chairperson

Dr. Ragni Ofstad	Matforsk, Norway

Panel member – Scientists

Prof. Jan Alexander	Norwegian Institute of Public Health, Norway
Prof. Lanfranco Conte	Universita Degli Studi Di Udine, Italy
Prof. Liam Donnelly	Teagasc, Ireland
Prof. Hanno Korkeala	University of Helsinki, Finland

Panel member- Stakeholders

Dr. Klas Hesselman	The Swedish Institute for Food and Biotechnology (SIK)

5. Animal Health

Chairperson

Prof. Dr. Dr. hc. Bernd Hoffmann	Justus-Liebig-Universität Giessen, Germany

Panel member – Scientists

Prof. David Church	Royal Veterinary College, University of London, UK
Prof. Pia Haubro Andersen	University of Copenhagen, Denmark
Prof. Dr. med. vet. Volker Moennig	School of Veterinary Medicine Hannover, Germany
Prof. Satu Pyörälä	University of Helsinki, Finland
Prof. Richard Wall	University of Bristol, UK

Panel member- Stakeholders

Dr. Per Arnesson	Frejahusdjur
Dr. Astrid Indrebö	The Norwegian Kennel Club and Norwegian School of Veterinary Science

6. Animal Husbandry

Chairperson

Prof. Ian Givens	University of Reading, UK

Panel member – Scientists

Prof. Dr. sc. agr. Dr. h.c Werner Bessei	University of Hohenheim, Germany
Prof. Eberhard von Borell	Martin-Luther-Universität Halle-Wittenberg, Germany
Prof. dr. ir. E. W. Brascamp	Wageningen University, The Netherlands
Prof. Patrick Kestemont	Facultes Universitaires Notre-Dame De La Paix Namur, Belgium

Panel member- Stakeholders

Dr. Jessica Kathle	Nordic Gene Bank
Dr. Erik Lindgren	Lantmännen

7. Biomedicine

Chairperson

Prof. Johanna Fink-Gremmels	Utrecht University, The Netherlands

Panel member – Scientists

Prof. Bernard Charley	INRA, France
Prof. Henk P. Haagsman	Utrecht University, The Netherlands
Prof. Rex A. Hess	University of Illinois, USA
Prof. Thor Landsverk	Norwegian College of Veterinary Medicine, Norway

Panel member- Stakeholders

Dr. Henrik Holst	Medical Products Agency, Sweden
Dr. Niklas Johansson	The Swedish Environmental Protection Agency

8. Forest Management and Products

Chairperson

Prof. Reino Pulkki	Lakehead University, Canada

Panel member – Scientists

Prof. Dr. Christoph Kleinn	Georg-August-Universität Göttingen, Germany
Prof. Annikki Mäkelä	University of Helsinki, Finland
Prof. Katia Ruel	Institut de Chimie Moléculaire de Grenoble (ICMG), France
Prof. Jaoa Pereira	Technical University of Lisbon, Portugal

Panel member- Stakeholders

Dr. Sven A. Svensson	Swedish Forestry Agency
Dr. Roger Asserståhl	Pharos Executive Partners

9. Biosystems Technology

Chairperson

Prof. dr. med. vet. Jörg Hartung	Tierärztliche Hochschule Hannover, Germany

Panel member – Scientists

Prof. Antti Asikainen	The Finnish Forest Research Institute
Prof. Richard Godwin	Cranfield University, UK

Panel member- Stakeholders

Dr. Lars Tegnér	Retired, previously The Swedish Energy Agency
Dr. Kjell Brännäs	Ministry of Agriculture and Forestry; Finland

10. Plant Protection

Chairperson

Prof. Thomas Baker	Pennsylvania State University, USA

Panel member – Scientists

Prof. Thomas Bruns	University of California, Berkeley, USA
Prof. Ring Cardé	University of California, Riverside, USA
Prof. Bill Fry	Cornell University, USA
Prof. Heikki Hokkanen	University of Helsinki, Finland
Prof. Linda Kohn	University of Toronto, Canada

Panel member- Stakeholders

Dr. Ola Kårén	Holmen Skog
Dr. Vibeke Bernson	Swedish Chemicals Agency

11. Plant Production

Chairperson

Prof. Michael Gooding	University of Reading, UK

Panel member – Scientists

Prof. Robert Graybosch	University of Nebraska-Lincoln, USA
Prof. Dr. rer. hort. Manfred Schenk	Institut für Pflanzenernährung, Germany
Prof. Dr. Friedhelm Taube	Christian-Albrechts-University Kiel, Germany
Prof. Kevin Vessey	Saint Mary's University, Canada

Panel member- Stakeholders

Dr. Stina Olofsson	Swedish Board of Agriculture
Dr. Anne-Charlotte Wallenhammar	HS Konsult AB

12. Soil and Aquatic Sciences

Chairperson

Prof. Katja Lajtha	Oregon State University, USA

Panel member – Scientists

Prof. Peter Grace	Queensland University of Technology, Australia
Prof. Mark Hodson	University of Reading, UK
Prof. Rickard Hooper	Consortium of Universities for Advancement of Hydrologic Science, USA
Prof. Roger Jones	University of Jyväskylä, Finland

Panel member- Stakeholders

Dr. Anne Lyche Solheim	Norwegian Institute for Water Research (NIVA)
Dr. Gunn Persson	SMHI

13. Plant Science

Chairperson

Prof. Chris Leaver	University of Oxford, UK

Panel member – Scientists

Prof. Vernonica Franklin-Tong	University of Birmingham, UK
Prof. Robert D. Guy	University of British Columbia, Canada
Prof. Knute Nadelhoffer	University of Michigan, USA
Prof. Elina Vapaavuori	The Finnish Forest Research Institute, Finland

Panel member- Stakeholders

Dr. Stine Tuvesson	Svalöf Weibull AB

14. Genetics and Breeding

Chairperson

Prof. Dr. Dr. h.c. Wolfgang Friedt	Justus Liebig University, Germany

Panel member – Scientists

Prof. Dave Burt	University of Edinburgh, UK
Prof. Jules Janick	Purdue University, USA
Prof. Wilf Keller	Genome Prairie, Canada
Prof. Hélène Lucas	Génétique et amélioration des plantes SGAP, France
Prof. Steve McKeand	North Carolina State University, USA

Panel member- Stakeholders

Dr. Eero Nissilä	Boreal
Dr. Hans Stålhammar	VikingGenetics

15. Chemistry, Molecular Biology and Microbiology

Chairperson

Prof. Dr. Ralph Conrad	Max Planck Institute for Terrestrial Microbiology, Germany

Panel member – Scientists

Prof. Andrew Fisher	University of California, USA
Prof. Jarl Rosenholm	Åbo Akademi University, Finland
Prof. Alfons Stams	Wageningen University, The Netherlands
Prof. Christine Raines	University of Essex, UK

Panel member- Stakeholders

Dr. Lars-Erik Nyström	GE Healthcare
Dr. Tomas Lundqvist	AstraZeneca R & D Mölndal

Appendix 2 Instructions for Scientific panels

1 Introduction

The Board of the Swedish University of Agricultural Sciences (SLU) has decided to evaluate the research and environmental monitoring and assessment[1] performed by SLU. The aim is to make an in-depth and objective assessment of the standing of SLU's research and environmental monitoring and assessment in an international perspective by evaluating its scientific quality, relevance and impact. The results will be presented by the end of 2009, and will form the basis for future strategic decisions made by the University. More background information about the evaluation and its objectives is available at http://www.slu.se/?id=1497 .

The evaluation, Quality and Impact, is divided into two parts, one focusing on the scientific quality and one on the use of the research.

2 Method of evaluation

The evaluation of the quality and impact of research and environmental monitoring and assessment carried out at SLU will comprise the following elements.

Scientific panels
International experts ("scientific panels") will evaluate the quality and relevance of research and environmental monitoring and assessment performed by SLU. Panel members have been recruited from abroad to ensure that SLU's research is evaluated in the light of international advances. There will also be two stakeholders on each panel with a broad overview of the needs of industry, authorities and/or society in general in the field. Information generated by self-assessments and bibliometrical analyses (see below) will be used to brief the panels. The panels will meet the Units of Assessment (UoA) at the Uppsala campus of SLU. Each panel will give an oral presentation and write a report on their results.

User panels
Examination of the relevance and impact of research will be performed by external assessors (mainly Swedish) from a user perspective ("user panels"). The evaluation will be based on in-depth interviews with users, selected parts of the reports from the scientific panels and selected parts of the information generated by the self-assessments. Each panel will give an oral presentation and write a report on their results.

Self-assessments
The UoAs, covering the entire scope of SLU research, have been asked to perform self-assessments. In this assessment each UoA will articulate its strategic aims for the future based on current strengths. UoAs have also been asked to quantify certain aspects of their research activities, particularly those that are indicators of international quality or relevance and

[1] In addition to research and education the Government has charged SLU with the task of conducting environmental monitoring and assessment ("FOMA"). Thus, SLU monitors the country's forests, agricultural landscapes, lakes, watercourses and species in order to analyse environmental trends.

impact. *Standardised operational data* from SLU databases (e.g. personnel, funding,) are included in the self-assessments.

Bibliometrical analysis
SLU has conducted a bibliometrical study of the research output of its researchers. This study focuses on the publication records of researchers within a given research field and compares the impact of their peer-reviewed publications with the average for an international community of peers, i.e. researchers in the same field. To reflect the present and future "brain-power" of SLU, all publications between 1998 and 2008 by research staff who are currently active will be considered, not only those they have produced while employed at SLU. Results of the bibliometrical analysis will be made available to the scientific panels for use in their assessment of the UoA.

Analysis and final report
The emphasis of the evaluation will be on describing the strengths, weaknesses and potential of the UoAs' activities, as well as any threats they face. Prerequisites essential for favourable development are to be described. The evaluation should make it possible to identify research environments that are scientifically strong, those with the potential to be scientifically successful, as well as those in need of scientific revitalisation. The evaluation should also enable SLU to identify areas that are, or have the potential to be, successful in contributing to sustainable societal development within the sectors concerned. The results of the evaluation are intended to provide guidance for strategic decisions, which will result in improvements in the scientific quality of the research and the impact it has, thus strengthening SLU's standing. This applies at all levels, from individual researchers to research teams, departments, faculties and the University Board. The Evaluation Management team will write a final, comprehensive report which will be based on the panel reports, among other things. The individual panel reports will be made available to the UoAs.

3 Research fields and Units of Assessment

Research carried out at SLU has been divided into 15 research fields (Table 1). Each research field consists of 2 to 15 Units of Assessments (UoA). The size of the UoA varies from about 2 to 30 scientists. A scientific panel of 7 - 9 experts will be appointed for each research field.

Table 1. Research fields in the evaluation of Quality and Impact (KoN)

Panel	**Research field**
1	Economics and Statistics
2	Landscape Architecture, Urban and Rural Development
3	Ecology and Environmental Sciences
4	Food Science and Safety
5	Animal Health
6	Animal Husbandry
7	Biomedicine
8	Forest Management and Products
9	Biosystems Technology
10	Plant Protection
11	Plant Production
12	Soil and Aquatic Sciences
13	Plant Science
14	Genetics and Breeding
15	Chemistry, Molecular Biology and Microbiology

4 Evaluation criteria for the scientific panels

A UoA represents a coherent area of research able to formulate a common research strategy. While the scientific panels will be expected to comment briefly on the profile of the entire *Research Field* at SLU and the relationships between the UoAs within it, their evaluation will *focus on the UoA*. It is the UoA that will be given recommendations to strengthen future activities and a *score* by the panel. Although the score awarded to any UoA is naturally important, the *comments and recommendations* of the scientific panels will have greater long-term value. The panels may also point out important research areas that are absent at SLU.

The evaluation made by scientific panels should take into account that UoAs vary in size. If the UoA is large (> 20 people), the panel should comment on a suitable sub-unit level.

As a basis for their evaluation, the panels will receive self-assessments carried out by the UoAs, including operational data from SLU's databases and a bibliometrical analysis of scientific publication.

The scientific panels will also visit SLU to conduct a dialogue with UoAs, from which they can make recommendations to the UoAs as well as to the faculties and University management, about how that area of research can best be developed. A schedule of interviews will be provided for each panel for this purpose.

4.1 The Criteria

SLU is a sectoral university, conducting *curiosity-driven research* as well as *needs-driven research***.** To gain an overall view, all research should be assessed both for its scientific quality and for its benefit to industry and society in general. Assessors should note that an individual UoA may have a profile solely in either "basic" or "applied" research, or a combination of both; there is no formal requirement that each UoA should comprise both kinds.

In addition, some UoAs at SLU combine research with environmental monitoring and assessment operations ("FOMA"; see p. 1). Although this part of the evaluation is focussed primarily on research, the scientific panels should include, where relevant, comments on FOMA and on the interaction between research and FOMA in their evaluation report.

SLU has endeavoured to define a versatile set of assessment criteria that best describe the multidisciplinary excellence required of a sectoral university. The assessment system adopted for this purpose has been particularly influenced by the system developed by KTH (the Royal Institute of Technology, Stockholm, Sweden)[2] , which was in turn inspired by a report published by the Royal Academy of Engineering in the UK[3]. It has also been influenced by evaluations recently conducted by other Swedish Universities[4].

The criteria for this part of the evaluation are:

[2] Focusing on Quality. International Research Assessment Exercise 2008, Project Report. KTH 2008.
[3] Measuring Excellence in Engineering Research. Royal Academy of Engineers. London 2000.
[4] KoF 07, Quality and Renewal 2007, An Overall Evaluation at Uppsala University. Uppsala University 2007; RQ08, Research Quality Assurance for the Future, A Quality Review of Research at Lund University 2007/08. Lund University 2008

1. Scientific quality
2. Recognition and leadership
3. Relevance and impact
4. Strategy and potential

1. Scientific quality

Scientific quality includes the *originality of ideas, choice of methods, scientific productivity, impact and prominence*. Both curiosity-driven research and needs-driven research should be evaluated. Indicators of use include: quality of scientific publications and other output, competitive national or international research grants, number of PhD exams, national or international centres of excellence, as well as major national and international collaborations.

Scientific quality will be evaluated on a scale of 1 - 6. The panels are encouraged to use the entire scale of scores in their evaluation. Scores are to be given for *performance*, meaning that even research focusing solely on Sweden or Scandinavia can be considered world-leading if the approach, methods used and findings are of the highest quality.

Scores will be awarded as follows. The UoA performs at a standard that is:

6	World-leading
5	High international
4	Internationally recognised
3	Moderate
2	Inadequate
1	Poor

Where possible, the scientific panels are encouraged to qualify their ratings by comparison with international groups and activities.

2. Recognition and leadership

Recognition and leadership includes *major commissions of trust in the scientific community as well as engagement with society in general, international recognition and visibility in society in general.* The evaluation should also include the attractiveness of the research environment, leadership, level of cooperation and communication within the UoA, as well as openness to new ideas.

Indicators of use include: major awards and prizes, academy fellowships, major engagements with government, inter-governmental organisations or commercial organisations, national and international scientific collaboration, collaboration with stakeholders, number of PhD students, postdoctoral fellows, and guest professors, PhD courses and invitations as key-note speaker.

Recognition and leadership will be evaluated on a scale of 1 - 6. The panels are encouraged to use the entire scale of scores in their evaluation. Scores will be awarded as follows:

6	Outstanding
5	Excellent
4	Good
3	Moderate
2	Inadequate
1	Poor

Where possible, the scientific panels are encouraged to qualify their ratings by comparison with international groups and activities.

3. Relevance and impact

Researchers in a sectoral university like SLU have a particular responsibility to consider and respond to the long-term needs of industry and society in general. Success requires that communication challenges are well negotiated and that any gaps in understanding between academia and society are addressed. However, this aspect will be dealt with in the separate impact evaluations by user panels and will not be assessed here.

Relevance in this context is to be understood as *the ability and future potential for generating knowledge that will contribute to sustainable development of society, including industry*. In assessing relevance, panels should focus on *the problems addressed and the general approach chosen by the UoAs.* Contribution to societal development can be exemplified as generating knowledge that is or will be needed by public authorities to develop policies or in international negotiations, to support decision making and management, increasing human or animal health or welfare, improving the efficiency of forestry or agricultural practices, mitigating the environmental impacts of forestry or agriculture, creating new opportunities for rural enterprises, improving living conditions in rural and urban areas, as well as improving economy, environment and health in developing countries.

Characteristic features of impact are high value interaction with public authorities, companies and other partners outside academia (including citizens), successful entrepreneurial activities or consultancy. Indicators of use include: major contracts with industry or public authorities, innovation activities (spin-offs or other companies, patents or other intellectual property, software etc), career of PhD students, major collaborative programmes involving non-academic partners, and commitment in cooperation with developing countries.

Relevance and impact may have various *geographical* and *temporal* dimensions. Assessors are therefore asked to describe the relevance and impact of the research problems addressed and approaches chosen by the UoA according to:

Geographical: a) regional/national; b) Nordic/European; c) global.
Temporal: a) short-term; b) medium-term; c) long-term perspective.

For each aspect, one or several options may be chosen.

An overall score for relevance and impact is to be given *irrespective of geographical or temporal scale.* When judging the degree of relevance and impact, assessors need not consider scientific quality of methods and results (these aspects will be assessed under the scientific quality criterion), nor the origin of the research problems, i.e. whether they were defined by the researcher(s) or by users/stakeholders.

Relevance and impact will be evaluated on a scale of 1 - 6. The panels are encouraged to use the entire scale of scores in the evaluation. Scores will be awarded as follows. For sustainable development of society including industry, the research performed by the UoA is, or will be of:

6	Utmost importance
5	Very high importance
4	High importance
3	Moderate importance
2	Little importance
1	No importance

Where possible the scientific panels are encouraged to qualify their ratings by comparison with international groups and activities.

4. Strategy and potential
The scoring should be based on the *UoA's skill in formulating an insightful, focused and ambitious but nevertheless realisable strategic plan as well as the potential of the UoA to develop successfully.*

The vitality and potential of a UoA is a function of group size and strength, quality and diversity of the researchers, group interactions, degree of interactions with stakeholders, mobility of researchers, strategic recruitments, interdisciplinary activities and essential supporting infrastructure such as equipment and administrative and technical support.

Indicators of use include: funding, size and profile of the research staff (including expertise, gender and age), national and international scientific collaboration, collaboration with stakeholders, new recruitments and the fostering of emerging talents.

Strategy and potential will be evaluated on a scale of 1 - 6. The panels are encouraged to use the entire scale of scores in the evaluation. A UoA's strategy and potential should be described as:

6	Outstanding
5	Excellent
4	Very good
3	Good
2	Inadequate
1	Poor

Where possible, the scientific panels are encouraged to qualify their ratings by comparison with activities in other international groups.

4.2 Different types of research profile

The scoring of a UoA will result in a research profile, illustrated as a "footprint" in a spider web diagram. A sectoral research university like SLU requires a range of research types from curiosity-driven to needs-driven research to be carried out within it. Different profiles therefore apply to different research areas or groups (examples are given in Figures 1a and 1b).

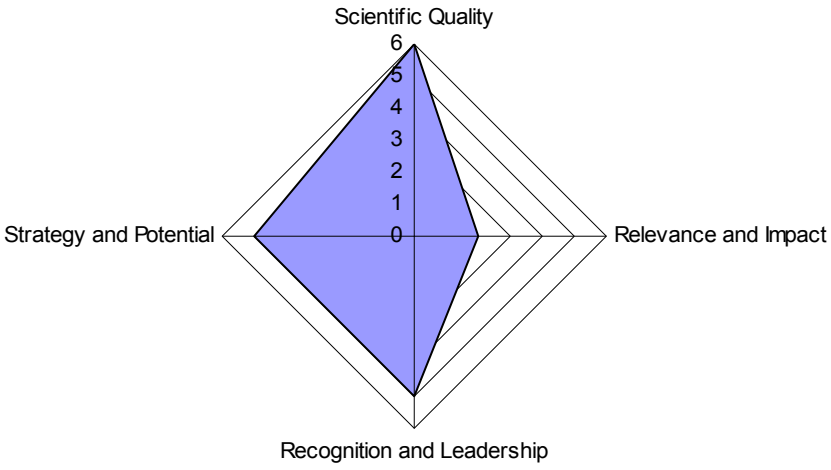

Figure 1a. A footprint of a Unit of Assessment that conducts well recognised, world-leading research and has a high potential.

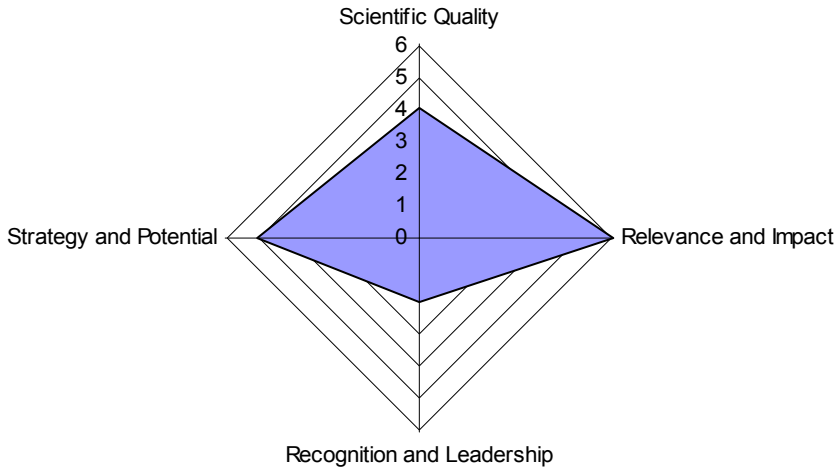

Figure 1b. A footprint of a Unit of Assessment that conducts research of high relevance and impact, and has a high potential.

5 Confidentiality and trust

The work performed by the panels must be impartial. A chairperson or a panel member may not have

- ongoing or recently concluded collaboration (later than 2003) with any person in a Unit of Assessment that will be assessed by the panel; or
- published (2004 or later) together with any person in a Unit of Assessment that will be assessed by the panel.

In addition, there must be no

- other particular circumstances that may affect confidence in the chairperson or panel member's impartiality, e.g. friendship or enmity with any person in a Unit of Assessment that will be assessed by the panel; or
- other connections with the Swedish University of Agricultural Sciences that may affect the impartiality of the outcome of the assessment.

A chairperson or a panel member may not use information that has been provided during the assessment (written or oral) to benefit their own or other colleagues' research, or use the information to discredit any person involved in the evaluation. The information made available to the panels should not be disseminated without prior contact with the Evaluation Management team.

If a panel member identifies a conflict of interest during the assessment, he or she should notify the chairperson, who will decide how to proceed in line with specific instructions from the Evaluation Management Team.

Appendix 3 Units of Assessments (UoA) included in the scientific evaluation and scores awarded by the panels

1), 2), 3), 4) For explanation see Notes on page 111.

No.	Scientific Panel / Research field	UoA Code	Unit of Assessment (UoA)	Department	Faculty 1)	SQ 2)	R & L	R & I	S & P	
1	Economics and Statistics	231-3	Forest Business Administration	Forest Products	S	2	3	6	3	
		295-3	Natural Resource Economics	Southern Swedish Forest Research Centre	S	4	3	4	2	
		300-1	Biostochastics	Forest Economics	S	5	5	5	6	
		300-2	Resource & Environmental Economics	Forest Economics	S	5	5	5	6	
		300-3	Forest Economics	Forest Economics	S	2	2	2	1	
		510-1	Agrarian History & Economic History	Economics	NL	n.a.	4	4	2	3)
		510-2	Agricultural Economics	Economics	NL	4	5	6	4	
		510-3	Environmental and Natural Resource Economics	Economics	NL	5	5	5	4	
		510-4	Agribusiness and Rural Development	Economics	NL	2	2	5	1	
		565-2	Biometry	Energy and Technology	NL	5	4	5	4	
		566-1	Applied Statistics	Unit of Applied Statistics and Mathematics	NL	3	3	3	4	
		638-2	Business Economics	Work Science, Business Economics and Environmental Psychology	LTJ	1	3	4	2	
2	Landscape Architecture, Urban and Rural Development	260-6	Rural Studies in Forest	Forest Resource Management	S	3	3	3	3	
		595-1	Rural Development	Urban and Rural Development	NL	5	5	5	5	
		595-2	Agroecology	Urban and Rural Development	NL	4	3	5	4	
		595-3	Environmental Communication	Urban and Rural Development	NL	5	5	5	6	
		595-4	Landscape Architecture	Urban and Rural Development	NL	3	3	4	4	
		595-5	Environmental Impact Assessment	Urban and Rural Development	NL	4	3	4	4	
		636-1	Design Theory and Research in Design	Landscape Architecture	LTJ	2	3	2	3	
		636-2	History and Heritage Research	Landscape Architecture	LTJ	5	4	3	2	
		636-3	Planning Research and Urban Theory	Landscape Architecture	LTJ	4	2	4	3	
		636-4	Landscape Analysis and Landscape Planning	Landscape Architecture	LTJ	5	4	4	4	
		637-1	Landscape Development with a Social Science Approach	Landscape Management, Design and Construction	LTJ	2	4	3	3	
		638-1	Work Science	Work Science, Business Economics and Environmental Psychology	LTJ	3	4	4	3	
		638-3	Environmental Psychology	Work Science, Business Economics and Environmental Psychology	LTJ	5	5	4	6	
		924-1	Sustainable Food Systems	Centre for Sustainable Agriculture (CUL)	NL	3	3	4	2	

3	Ecology and Environmental Sciences	241-2	Forest Vegetation Ecology	Forest Ecology and Management	S	6	6	6	6	
		251-1	Wildlife, Fish and Environmental Studies	Wildlife, Fish and Environmental Studies	S	4	6	6	5	
		260-7	National Inventory of Landscapes in Sweden	Forest Resource Management	S	n.a.	3	4	5	
		295-4	Forest History and Forest Vegetation Ecology	Southern Swedish Forest Research Centre	S	3	3	3	2	
		415-2	Landscape and Soil Ecology	Ecology	NL	4	5	5	4	
		415-5	Conservation Biology	Ecology	NL	4	5	5	4	
		415-6	Population Biology	Ecology	NL	5	5	4	5	
		415-8	Systems Ecology	Ecology	NL	6	5	5	4	
		415-9	Wildlife Ecology	Ecology	NL	4	5	5	5	
		713-1	Ecotoxicology	Biomedical Sciences and Veterinary Public Health	VH	4	5	6	3	
		910-4	Swedish Biodiversity Centre	Swedish Biodiversity Centre (CBM)	NL	n.a.	5	6	3	
4	Food Science and Safety	550-1	Food Science	Food Science	NL	5	4	3	4	
		713-2	Toxicological Food Safety	Biomedical Sciences and Veterinary Public Health	VH	4	4	3	3	
		713-3	Microbiological Food Safety	Biomedical Sciences and Veterinary Public Health	VH	4	3	3	3	
5	Animal Health	712-2	Biomechanics and Applied Physiology	Anatomy, Physiology and Biochemistry	VH	4	4	3	4	
		713-6	Bacteriology	Biomedical Sciences and Veterinary Public Health	VH	4	3	4	2	
		713-7	Virology	Biomedical Sciences and Veterinary Public Health	VH	5	5	5	4	
		713-8	Parasitology	Biomedical Sciences and Veterinary Public Health	VH	5	5	4	4	
		715-1	Small Animal Surgery	Clinical Sciences	VH	3	2	3	2	
		715-2	Large Animal Surgery	Clinical Sciences	VH	1	2	2	1	
		715-5	Ruminant Medicine	Clinical Sciences	VH	4	4	5	3	
		715-7	Small Animal Medicine	Clinical Sciences	VH	5	6	5	4	
		715-11	Reproduction	Clinical Sciences	VH	5	5	4	5	
		715-12	Veterinary Epidemiology	Clinical Sciences	VH	3	3	3	3	
		715-13	Clinical diagnostics and equine, porcine and laboratory animal medicine	Clinical Sciences	VH	2/4/4/5	-/4/4/4	2/4/5/4	-/2/3/3	4)
		880-2	Animal Hygiene	Animal Environment and Health	VH	4	5	5	4	

6	Animal Husbandry	251-2	Aquaculture	Wildlife, Fish and Environmental Studies	S	4	4	4	3	
		540-1	Animal Husbandry	Agricultural research for Northern Sweden	NL	3	3	4	5	
		650-1	Monogastric Animals, Nutrition	Animal Nutrition and Management	VH	3	2	3	3	
		650-2	Ruminants, Nutrition	Animal Nutrition and Management	VH	5	3	4	4	
		650-3	Ruminants, Management	Animal Nutrition and Management	VH	4	3	4	4	
		650-4	Poultry, Nutrition and Management	Animal Nutrition and Management	VH	3	5	5	3	
		650-5	Feed Science	Animal Nutrition and Management	VH	3	3	4	3	
		670-2	Quantitative Genetics and Animal Breeding	Animal Breeding and Genetics	VH	5	5	5	3	
		880-1	Ethology and Animal Welfare	Animal Environment and Health	VH	5	5	6	5	
		880-4	Production Systems	Animal Environment and Health	VH	3	3	3	3	
		882-1	Reindeer Husbandry Unit	Reindeer Husbandry Unit	VH	2	3	3	2	
7	Biomedicine	712-1	Medical Biochemistry	Anatomy, Physiology and Biochemistry	VH	5	4	5	4	
		712-3	Domestic Animal Structure and Function	Anatomy, Physiology and Biochemistry	VH	3	3	3	2	
		713-4	Pharmacology and Toxicology	Biomedical Sciences and Veterinary Public Health	VH	3	3	5	3	
		713-5	Pathology	Biomedical Sciences and Veterinary Public Health	VH	4	4	4	4	
		713-9	Immunological Veterinary Medcine	Biomedical Sciences and Veterinary Public Health	VH	4	4	5	3	
8	Forest Management and Products	210-1	Forest, Landscape and Society	School for Forest Engineers	S	3	4	5	4	
		231-1	Wood Science and Fibre Biology	Forest Products	S	6	5	6	6	
		231-2	Wood Technology	Forest Products	S	3	4	4	3	
		231-4	Forest Policy and Global forestry	Forest Products	S	1	1	2	1	
		241-1	Forest Management	Forest Ecology and Management	S	5	5	5	5	
		260-1	Forest Planning (north)	Forest Resource Management	S	4	4	5	4	
		260-2	Forest Operations and Techniques	Forest Resource Management	S	3	2	4	4	
		260-3	Remote Sensing	Forest Resource Management	S	5	6	6	6	
		260-4	Swedish National Forest Inventory	Forest Resource Management	S	n.a.	n.a.	n.a.	n.a.	
		260-5	Forest Inventory	Forest Resource Management	S	4	5	5	4	
		295-1	Silviculture, Forest Growth and Yield	Southern Swedish Forest Research Centre	S	5	5	5	4	
		295-2	Forest Planning (south)	Southern Swedish Forest Research Centre	S	4	3	4	5	
		330-3	Tropical Silviculture	Forest Genetics and Plant Physiology	S	3	4	4	3	

9	Biosystems Technology	435-2	Soil and Water Management	Soil and Environment	NL	5	5	5	5	
		545-1	Biomass Engineering and Technology	Unit of Biomass Technology and Chemistry	NL	5	6	5	5	
		565-1	Bioenergy from Woody Biomass	Energy and Technology	NL	3	3	3	3	
		565-3	Technology	Energy and Technology	NL	4	3	5	4	
		634-1	Farming Systems, including Technology	Agriculture - Farming Systems, Technology and Product Quality	LTJ	3	3	3	3	
		635-1	Animal Environment and Building Function	Rural Buildings and Animal Husbandry	LTJ	4	3	4	4	
		635-2	Rural Building Design	Rural Buildings and Animal Husbandry	LTJ	2	3	4	4	
		635-3	Climate, Energy and Environmental Technology	Rural Buildings and Animal Husbandry	LTJ	4	3	4	3	
		637-2	Landscape Development with a Natural Science/ Technical Approach	Landscape Management, Design and Construction	LTJ	2	3	3	3	
10	Plant Protection	390-1	Plant-Soil-Microorganism Interactions	Forest Mycology and Pathology	NL	6	6	4	6	
		390-2	Agricultural Plant Pathology	Forest Mycology and Pathology	NL	5	5	4	6	
		390-3	Forest Pathology and Mycology	Forest Mycology and Pathology	NL	6	6	6	6	
		390-4	Epidemiology of Plant Pathogens	Forest Mycology and Pathology	NL	4	4	4	4	
		415-1	Insect - Plant Interactions	Ecology	NL	4	4	5	4	
		415-3	Agricultural Entomology	Ecology	NL	5	5	5	5	
		415-7	Forest Entomology	Ecology	NL	4	5	5	3	
		632-1	Chemical Ecology	Plant Protection Biology	LTJ	6	5	6	6	
		632-2	Integrated Plant Protection	Plant Protection Biology	LTJ	2	3	5	3	
		632-3	Resistance Biology	Plant Protection Biology	LTJ	2	3	3	3	
11	Plant Production	500-1	Ecology of Cultivation Systems	Crop Production Ecology	NL	4	4	4	2	
		500-2	Crop Physiology	Crop Production Ecology	NL	4	4	4	2	
		500-3	Short Rotation Forestry	Crop Production Ecology	NL	4	4	3	2	
		500-4	Weed Biology and Management	Crop Production Ecology	NL	3	3	3	2	
		540-2	Crop Science	Agricultural research for Northern Sweden	NL	4	3	4	2	
		633-1	Microbial Horticulture Laboratory	Horticulture	LTJ	4	4	4	4	
		633-2	Horticultural Product Quality and Post Harvest	Horticulture	LTJ	5	5	5	5	
		633-3	Horticultural Production Physiology	Horticulture	LTJ	1	2	3	1	
		634-3	Product Quality	Agriculture - Farming Systems, Technology and Product Quality	LTJ	4	4	3	4	

12	Soil and Aquatic Sciences	241-3	Soil and Plant-Soil Interactions	Forest Ecology and Management	S	6	6	5	6	
		280-1	Aquatic Geochemistry and Environmental Chemistry	Aquatic Sciences and Assessment	NL	5	5	4	3	
		280-2	Aquatic Ecology and Biodiversity	Aquatic Sciences and Assessment	NL	4	3	5	5	
		435-1	Soil Carbon and Greenhouse Gases	Soil and Environment	NL	4	4	5	3	
		435-3	Plant Nutrition and Soil Biology	Soil and Environment	NL	4	3	3	2	
		435-4	Biogeochemistry	Soil and Environment	NL	2	2	2	1	
		435-5	Biogeophysics and Water Quality	Soil and Environment	NL	4	3	4	3	
		435-6	Precision Agriculture and Pedometrics	Soil and Environment	NL	3	3	5	3	
13	Plant Science	330-1	Experimental Plant Biology and Forest Biotechnology	Forest Genetics and Plant Physiology	S	6	5	5	4	
		480-1	Molecular Plant Biology	Plant Biology and Forest Genetics	NL	5	4	4	5	
14	Genetics and Breeding	330-2	Forest Genetics	Forest Genetics and Plant Physiology	S	2	1	3	2	
		480-2	Genetics and Plant Breeding	Plant Biology and Forest Genetics	NL	4	5	5	6	
		631-1	Agricultural Plant Breeding Research	Plant Breeding and Biotechnology	LTJ	3	4	5	3	
		631-2	Plant Biotechnology	Plant Breeding and Biotechnology	LTJ	4	5	4	5	
		631-4	Horticultural Plant Breeding Research	Plant Breeding and Biotechnology	LTJ	3	4	5	4	
		670-1	Molecular genetics and bioinformatics	Animal Breeding and Genetics	VH	6	6	6	6	
15	Chemistry, Molecular Biology and Microbiology	420-1	Molecular Biology	Molecular Biology	NL	5	4	4	4	
		450-1	Organic Chemistry, Natural Product Chemistry	Chemistry	NL	5	4	5	4	
		450-2	Inorganic and Physical Chemistry	Chemistry	NL	4	3	3	4	
		450-3	Solid State Inorganic Chemistry	Chemistry	NL	4	4	4	4	
		460-1	Microbiology	Microbiology	NL	4	4	6	5	

Notes:	1) Faculties at SLU LTJ= Faculty of Landscape Planning, Horticulture and Agricultural Science NL= Faculty of Natural Resources and Agricultural Sciences S= Faculty of Forest Sciences VH= Faculty of Veterinary Medicine and Animal Science
	2) 17Assessment criteria (scores awarded by the panels on a scale from 1 to 6) SQ= Scientific Quality R&L= Recognition and Leadership R&I = Relevance and Impact S&P =Strategy and Potential n.a.= no score awarded
	3) Supplementary assessment of Scientific Quality obtained from two independent experts: score 5
	4) Individual scores were given to four subunits
	The Centre for Image Analysis (CBA), which is jointly organized by SLU and Uppsala University, was not included since it was recently subject to a similar evaluation by Uppsala University (Quality and Renewal 2007), http://usxs.fysik.uu.se/main.php/KoF07.pdf?fileitem=8225372

Appendix 4 Stakeholder panels

Stakeholder panels (’Intressentpaneler’)

I. Food (agriculture and horticulture, farm animals, aquaculture)
’Livsmedel (jord- och trädgårdsbruk, husdjur, vattenbruk’)

Annika Åhnberg (Chairperson)	Konsult
Carl-Anders Helander	HS Skaraborg
Carl-Johan Lidén	Jordbruksverket
Christina Möller	Sveriges konsumenter
Eva Karin Hempel	LRF
Jan Rundqvist	GU Holding / pro-con
Lars Plym Forshell	Livsmedelsverket
Ole Lind	DeLaval
Thomas Svaton	Svensk dagligvaruhandel

II. Animal Health and Welfare
(’Djurhälsa och djurvälfärd’)

Lennart Andersson (Chairperson)	Svenskmjölk
Göran Ask	Svenska Djursjukhusföreningen
Ingrid Mossberg	Jordbruksdepartementet
Jan-Åke Robertsson	Svenska Djurhälsovården
Karin Åhl	Jordbruksverket
Peter Kallings	Stiftelsen Svensk Hästforskning
Ulf Uddman	Svenska Kennelklubben

III. Raw Materials for Energy and Industry (fibres, timber, energy, etc.)
(‘Energi- och industriråvaror (fiber, virke, energi, m.fl.’)

Jan-Åke Lundén (Chairperson)	LRF Skogsägarna
Erik Herland	Lantmännen Energi
Eva Pettersson	SLF
Gustav Melin	Svebio
Jan Gustafsson	Stora Enso Skog
Johan Wester	Skogsstyrelsen, Skog Nord

IV. Spatial Planning, Environment and Nature (urban and rural areas, recreation, health and leisure)
('Samhällsplanering, miljö och natur (stad—land, rekreation, hälsa och fritid')

Mårten Dunér (Chairperson)	Boverket
Börje Pettersson	Bergvik Skog
Fredrik Wallin	Flens Kommun
Jens Balsby Nielsen	Danska Slottsförvaltningen
Katarina Schylberg	Miljödepartementet
Ulf Silvander	Svenskt friluftsliv

V. Environmental Monitoring and Assessment (Foma)
('Fortlöpande miljöanalys')

Manuela Notter (Chairperson)	Naturvårdsverket
Hans Oscarsson	Länsstyrelsen
Linda Berglund	WWF
Magnus Fridh	Skogsstyrelsen
Martin Sjödahl	Jordbruksverket
Nils-Gunnar Lindqvist	Kemikalieinspektionen
Tomas Thuresson	Häradsskog

Appendix 5 Instructions for Stakeholder panels *(in Swedish)*

1. Bakgrund och syfte

SLU forskar, utbildar, informerar och bedriver Fortlöpande miljöanalys inom den gröna sektorn.

SLU:s styrelse har beslutat att universitetets forskning ska utvärderas som ett led i en kvalitetsutveckling (http://kon.adm.slu.se/ShowPage.cfm?OrgenhetSida_ID=10215). Det övergripande målet är att SLU ska vara ett världsledande universitet inom Life Science området och vara:

- Eftertraktat för sin höga kvalitet och kreativitet
- Nyskapande och tongivande inom miljöanalys
- Efterfrågat som en innovativ partner för den gröna sektorn

Utvärderingen omfattar dels den vetenskapliga kvaliteten, dels SLU:s faktiska eller upplevda ”nytta”. Utbildningen utvärderas inte annat än ur intressentperspektiv. Andra svenska universitet har genomfört eller kommer att genomföra utvärderingar av den vetenskapliga kvaliteten, medan en djuplodande evaluering av nyttoaspekten hitintills är unik för SLU. Nyttodelen av utvärderingen utgör också en viktig del av SLU:s utökade dialog med sina intressenter.

Syftet med nyttoutvärderingen är att:

- identifiera områden som är, respektive har potential att bli, framgångsrika i att bidra till en positiv samhällsutveckling inom berörda sektorer
- identifiera områden där SLU bör bidra till en positiv samhällsutveckling, men idag inte gör det eller är svagt inom området
- ge vägledande underlag för strategiska beslut för ökad nytta (på forskar-, institutions-, fakultets- och övergripande- nivå)
- visa vilken nytta samhället (intressenterna) har av SLU:s forskning och Fortlöpande Miljöanalys (Foma) och vilka mervärden de ger
- tydliggöra SLU:s styrkeområden för omvärlden som underlag för utökat gemensamt värdeskapande

2. Uppgift

Intressentpanelernas uppgift är att med hjälp av egen erfarenhet, sammanställt underlagsmaterial (*se bilaga 1*), samt muntliga presentationer från de vetenskapliga panelernas relevanspersoner och intervjuundersökningen granska och värdera SLU- forskningens nyttiggörande. Bedömningen görs områdesvis utifrån följande kriterier:

1. Teknisk kvalitet och relevans - forskar SLU inom rätt områden?
2. Funktionell kvalitet – hur har kunskapen utvecklats, paketerats och förmedlats?
3. SLU:s image – hur synligt är SLU, vilka mervärden upplevs SLU ha?
4. Framtida utmaningar – vilka potentialer till ökad nytta finns och hur bör SLU agera för att tillvarata dessa?

Detaljerad beskrivning av kriterierna framgår av *bilaga 2* (panel I-IV*)* resp. *bilaga 3* (panel V).

Panelerna uppmanas att lyfta fram enskilda grupperingar som man anser gör särskilt värdefulla insatser och motivera dessa, dvs. peka på viktiga faktorer som leder till framgång. Viktigt är att också lyfta fram områden där kompetens, forskning och/eller kommunikation saknas eller är otillräcklig sett ur intressentsynpunkt. Nyttobedömningens resultat ska så långt möjligt återföras till forskargrupper, både i sina generella delar och specifikt genom bl.a. ”Goda exempel”.

Intressentpanelerna ska redovisa sina slutsatser både muntligt och skriftligt, se *bilaga 4*.

3. Områden

Bedömningen görs av SLU som helhet, dvs. ingen enskild bedömning sker på forskargruppsnivå. Fyra områden har valts med produkt/tjänst som utgångspunkt, och som femte område bedöms Fortlöpande miljöanalys:

I. Livsmedel (Jord- och trädgårdsbruk, husdjur, vattenbruk)
II. Djurhälsa och djurvälfärd
III. Energi- och industriråvaror (Fiber, virke, energi, m.fl., skogsbruk, jordbruk)
IV. Samhällsplanering, miljö och natur (Stad och land, rekreation, hälsa och fritid)
V. Fortlöpande miljöanalys (Foma)

Bilaga 1

Underlag för bedömningen

Intressentpanelernas bedömning avser att fokusera på att spegla intressenternas upplevda kvalitet, dvs. den bedömda nyttan.

Bedömningen baseras på panelernas erfarenheter, resultat från djupintervjuer av viktiga SLU-intressenter, utbildningsstatistik, centrumbildningars självvärderingar av sina relationer till omvärlden samt rapporter från vetenskapliga paneler, vars bedömning av ”Relevance and Impact” genomfördes i början av maj månad.

Tillgängligt för panelerna kommer dessutom att finnas utdrag från de 130 forskargruppernas självvärderingar.

För panel V, Foma, tillkommer programvisa självvärderingar.

Panelerna kommer att fortlöpande få tillgång till underlagsmaterialet via en webbsida i takt med att detta blir tillgängligt.

Rapport från intervjuundersökning

Intervjuer med ett 30-tal av SLU:s viktigaste intressenter sker med hjälp av extern expertis. Här kommer synen på och samverkan med SLU:s forskning att beskrivas och analyseras. En rapport från intervjuundersökningen ingår som underlag för nyttopanelernas arbete.

Foma självvärderingar

Koordinatorerna för SLU:s Foma-program beskriver programmens verksamhet, analyserar resultat och trender samt gör en enkel SWOT-analys (strengths, weaknesses, opportunities and threats). Underlag för arbetet är bl.a. de självvärderingar som SLU:s forskargrupper skrivit och de vetenskapliga panelernas rapporter. Dessa självvärderingar utgör underlag för panel V.

Utbildningsstatistik

Utvalda data från SCB:s arbetsmarknadsundersökning för såväl grund- som forskarutbildning har sammanställts och kan användas för bedömningen av SLU som rekryteringsbas.

Självvärderingar

Självvärderingar har gjorts av ett tiotal centrumbildningar med inriktning på externa relationer. Tillgängligt finns också utdrag från forskargruppernas självvärderingar där man presenterar sin egen syn på nuvarande status och möjliga framtida utveckling. De ger en bild av viktiga nyttoaspekter, t ex externfinansiering, vilken ny kunskap/nya resultat som respektive forskargrupp bidragit med och för vem, hur och i vilken omfattning användare har deltagit i forskningen (initiering, finansiering, empiriska data, erfarenheter, implementering) samt vilka stora/viktiga utmaningar man upplever som nyttoskapare inför framtiden.

Vetenskapliga panelernas bedömning ”Relevance and Impact”

De vetenskapliga panelernas nyttobedömning tar sin utgångspunkt i en ”kollegial bedömning”, som innebär att ”medlemmar av en profession utvärderar andra professionsmedlemmars arbete och verksamhet utifrån yrkeskårens egna kvalitetskriterier”. I SLU:s utvärdering har detta gjorts av vetenskapliga paneler bestående av 5-7 internationella forskare och 1-2 ”relevanspersoner”. Relevanspersonerna representerar ett svenskt (eller i några fall nordiskt) perspektiv och med kännedom om svenska förhållanden. 15 vetenskapliga paneler besökte och utvärderade SLU:s forsknings kvalitet och relevans vecka 19. De delar av rapporterna som berör nyttan överförs till intressentpanelerna, dels genom skriftliga rapporter från de vetenskapliga panelerna, dels muntligt vid en workshop där minst en av relevanspersonerna från var och en av de vetenskapliga panelerna deltar. Workshopen hålls på eftermiddagen den 23 juni och blir starten för intressentpanelernas arbete.

Bilaga 2

Kriterier och indikatorer för panelerna I-IV

Inledning

SLU:s roll i samhället kan tolkas utifrån Högskoleverkets förslag. Det innebär att SLU bidrar till samhällsutvecklingen inom tre områden:

- *Demokratiutveckling*

Innefattar en förtroendefull dialog/kommunikation med övriga samhället, inte minst allmänhet och politiker (folkbildning, underlag för politiska beslut m.m.) genom populärvetenskaplig publicering, deltagande i seminarier, samhällsdebatt osv. Detta för att ge människor möjlighet att själva handla/agera, delta i den demokratiska processen och att medverka till forskningens utveckling. Det innebär att förtroende och tillit för forskningens bidrag till en positiv samhällsutveckling måste skapas och därmed motiv och engagemang för fortsatt skattefinansiering.

- *Kunskapsutveckling och tillväxt*

SLU ingår i ett kunskaps- och innovationssystem med syfte att bidra såväl med underlag för beslut m.m. som att utveckla resultat, metoder och produkter för kommersialisering i offentlig sektor och näringsliv. Betoningen ligger på att se kunskaps- respektive innovations-processerna som helhet och vilka strategier/roller och incitament som SLU har utvecklat.

- *Utveckling av rekryteringsbasen*

Innehållet i utbildningarna (grund-, forskar- och uppdragsutbildning) förväntas möta efterfrågan på arbetsmarknaden (studenternas ”anställningsbarhet”). Hur ser bl.a. anställningssituationen ut efter examen och vilka omvärldskontakter ingår under utbildningarna?

SLU:s verksamhet ska kännetecknas av dels stark koppling mellan utbildning och forskning av internationell klass, dels att den ska bedrivas i nära samverkan med sektorernas intressenter.

Nyttobegreppet är mångfacetterat och svårdefinierat. SLU:s utvärdering fokuserar på en integrerad syn på ”nyttokvalitet”, som speglar den upplevda kvaliteten. Resultatet blir därmed *bedömd* nytta som ger uttryck för överensstämmelsen mellan förväntningar och hur dessa uppfyllts. Till detta kommer synen på SLU (”SLU:s image”). Nyttovärderingen bör granska resultat (direkta), effekter (på längre sikt), processer och förutsättningar ur ett intressentperspektiv.

Kriterier

De kriterier som ska bedömas är:

1. Teknisk kvalitet och relevans - forskar SLU på rätt saker?
2. Funktionell kvalitet – hur har kunskapen utvecklats, paketerats och förmedlats?
3. SLU:s image – hur synligt är SLU, vilka mervärden upplever ni att SLU har?
4. Framtida utmaningar – vilka potentialer till ökad nytta finns och hur bör SLU agera för att tillvarata dessa?

För de tre första kriterierna ska panelerna kommentera den bild/bilder som presenteras i underlagen (se bilaga 1) och komplettera utifrån egna erfarenheter.

Det fjärde kriteriet är det viktigaste och panelerna bör ägna mest tid åt detta. Huvudtyngdpunkten bör ligga på att ge inspel, idéer, tankar och förslag inför SLUs fortsatta arbete med att utveckla nyttan genom ömsesidigt värdeskapande.

1. Teknisk kvalitet och relevans

Avser bedömning av *vad* som levererats, dvs. har SLU forskat på rätt saker ur nyttosynpunkt såväl direkt som på längre sikt. I vilken grad har kunskapen varit relevant och lett till resultat för respektive intressent? Vilka produkter, tjänster, funktioner, beslutsunderlag har genererats? Exempel på områden där det fungerar bra/mindre bra/saknas bör ingå.

2. Funktionell kvalitet

Avser bedömning av *hur* kunskapen utvecklats, paketerats och förmedlats. Hur har den differentierats och anpassats till respektive intressent, dvs. nyttan i sitt sammanhang. Hur tas externimpulser tillvara? Hur ser processerna ut, dvs. hur arbetar SLU utifrån ett kund/ intressentperspektiv? Miljön där forskning möter övriga samhället, dvs. informationen, kommunikationen/dialogen är viktig. Vilka är arenorna, nätverken, mötesplatserna, kommunikationsverktygen? Exemplifiera vilka som har fungerat bra/mindre bra/saknas? Vilka är kännetecknen för framgångsrik nytta?

3. SLU:s image

Avser vilken syn på SLU man har. Vilket anseende har SLU och hur synligt är SLU? På vilket/vilka sätt behövs SLU? Vilka är SLU:s mervärden? Vilka är förhållningssätten och incitamenten till att dra nytta av forskningens resultat?

4. Framtida utmaningar

Avser att belysa vilka potentialer till ökad nytta som finns hos SLU och hur dessa kan utvecklas och utnyttjas. Vilka är de avgörande strategiska forskningsområdena att utveckla (teknisk kvalitet och relevans)? Vilka är de avgörande processerna och hur kan de utvecklas (funktionell kvalitet)? Hur kan synen på SLU utvecklas (image)?

Panelerna får även möjlighet att lämna övriga synpunkter. De kan t.ex. avse samspelet mellan forskning och utbildning, balansen mellan intern (statsanslag) och extern finansiering, avvägning mellan regionalt, nationellt och internationellt arbete eller andra synpunkter som panelen vill framföra.

Bilaga 3

Kriterier och indikatorer för panel V: Fortlöpande miljöanalys

Inledning

SLU:s roll i samhället kan tolkas utifrån Högskoleverkets förslag. Det innebär att SLU bidrar till samhällsutvecklingen inom tre områden:

- *Demokratiutveckling*

Innefattar en förtroendefull dialog med övriga samhället, inte minst allmänhet och politiker (folkbildning, underlag för politiska beslut m.m.) genom populärvetenskaplig publicering, deltagande i seminarier, samhällsdebatt osv. Detta för att ge människor möjlighet att själva agera, delta i den demokratiska processen och att medverka till kunskapens utveckling. Det innebär att förtroende och tillit för universitetets bidrag till en positiv samhällsutveckling måste skapas och därmed motiv och engagemang för fortsatt skattefinansiering.

- *Kunskapsutveckling och tillväxt*

SLU ingår i ett kunskaps- och innovationssystem med syfte att bidra såväl med underlag för beslut m.m. som att utveckla resultat, metoder och produkter för kommersialisering i offentlig sektor och näringsliv. Betoningen ligger på att se kunskaps- respektive innovationsprocesserna som helhet och vilka strategier/roller och incitament som SLU har utvecklat.

- *Utveckling av rekryteringsbasen*

Innehållet i utbildningarna (grund-, forskar- och uppdragsutbildning) förväntas möta efterfrågan på arbetsmarknaden (studenternas ”anställningsbarhet”). Hur ser bl. a. anställningssituationen ut efter examen och vilka omvärldskontakter ingår under utbildningarna?

SLU:s verksamhet ska kännetecknas av dels stark koppling mellan utbildning, forskning och fortlöpande miljöanalys av internationell klass, dels att den ska bedrivas i nära samverkan med sektorernas intressenter.

SLU har regeringens uppdrag att bedriva Fortlöpande miljöanalys (Foma). SLU:s styrelse har fastställt följande syfte och nedanstående mål:

"Fortlöpande miljöanalys syftar till att följa växlingar i miljöns tillstånd, värdera problem och lämna underlag för ett hållbart nyttjande av naturresurserna."

SLU skall vara en ledande kunskapskälla rörande miljötillståndet i Sverige och omvärlden genom att inom sitt område:

- vara utförare av nationell och regional miljöövervakning
- som datavärd insamla, förvalta och tillhandahålla nationella och regionala miljödata
- ha beredskap för och fortlöpande åstadkomma beskrivningar, analyser och prognoser av miljötillståndet relativt miljömålen
- utveckla system för insamling, analys och presentation av miljödata och miljöinformation, särskilt metodik för tolkning, konsekvensanalyser och prognoser
- inom ramen för en SLU-gemensam profil tillhandahålla resultat från fortlöpande miljöanalys i skrift, över Internet och direkt
- medverka i internationellt samarbete på miljöområdet och för olika sakområden utgöra nationellt referenscentrum eller motsvarande.

Arbetet organiseras i program med fokus på angelägna områden. I programmen prioriteras arbete med de svenska miljökvalitetsmålen och Sveriges internationella miljöåtaganden i konventioner och direktiv.

Nyttobegreppet är mångfacetterat och svårdefinierat. SLU:s utvärdering fokuserar på en integrerad syn på ”nyttokvalitet”, som speglar den upplevda kvaliteten. Resultatet blir därmed *bedömd* nytta som ger uttryck för överensstämmelsen mellan förväntningar och hur dessa uppfyllts. Till detta kommer synen på SLU (”SLU:s image”). Nyttovärderingen bör granska resultat (direkta), effekter (på längre sikt), dialog och potentialer ur ett intressentperspektiv.

Kriterier

De kriterier som ska bedömas är:

1. Teknisk kvalitet och relevans - arbetar SLU med rätt saker?
2. Funktionell kvalitet – hur har resultaten arbetats fram och förmedlats?
3. SLU:s image – hur synligt är SLU, vilka mervärden upplever ni att SLU har?
4. Framtida utmaningar – vilka potentialer till ökad nytta finns och hur bör SLU agera för att tillvarata dessa?

1. Teknisk kvalitet och relevans

Avser bedömning av *vad* som levererats, dvs. har SLU arbetat med rätt saker ur nyttosynpunkt, såväl på kortare som på längre sikt. Är SLU:s Foma-program de rätta och balansen mellan dem? Är kvaliteten i genomförandet väl avvägd? I vilken grad har kunskapen varit relevant och lett till resultat för respektive intressent? Vilka beskrivningar, analyser, prognoser och beslutsunderlag har genererats? Exempel på områden där det fungerar bra/mindre bra/saknas bör ingå och exempel på kvalitetsbrister.

2. Funktionell kvalitet

Avser bedömning av *hur* kunskapen utvecklats, paketerats och förmedlats. Hur har den differentierats och anpassats till respektive intressent, dvs. nyttan i sitt sammanhang. Hur ser dialogen ut, dvs. hur arbetar SLU utifrån ett kund/ intressentperspektiv? Miljön där miljöanalysen möter övriga samhället, dvs. informationen, kommunikationen är viktig. Vilka är arenorna, nätverken, mötesplatserna, kommunikationsverktygen? Exemplifiera vilka som har fungerat bra/mindre bra/saknas? Vilka är kännetecknen för framgångsrik nytta?

3. SLU:s image

Avser vilken syn på SLU man har. Vilket anseende har SLU och hur synligt är SLU? Behövs SLU? Vilka är SLU:s mervärden? Vilka är förhållningssätten och incitamenten till att dra nytta av den fortlöpande miljöanalysens resultat?

4. Framtida utmaningar

Avser att belysa vilka potentialer till ökad nytta som finns hos SLU och hur dessa kan utvecklas och nyttjas. Vilka är de avgörande strategiska områdena att utveckla (teknisk kvalitet och relevans)? Vilka är de avgörande processerna och hur kan de utvecklas (funktionell kvalitet)? Hur kan synen på SLU utvecklas (image)?

Panelen får även möjlighet att lämna övriga synpunkter om Foma. De kan t.ex. avse t.ex. samspelet mellan forskning, utbildning och fortlöpande miljöanalys, balansen mellan intern (statsanslag) och extern finansiering, avvägning mellan regionalt, nationellt och internationellt arbete, balansen mellan datainsamling, analys och presentation av resultat.

Bilaga 4

Rapportering

Muntlig rapport

Muntlig rapportering till SLU:s ledning och KoN:s projektgrupp görs 25 juni. Varje panel har 50 minuter som innefattar tid för presentation av slutsatser (max 25 min.) samt frågor och diskussion.

Skriftlig rapport

Skriftlig redovisning, ca 10 sidor (på svenska) innefattande dels generella iakttagelser, dels specifika enligt rapportmall lämnas i prel. version den 25 juni och slutlig den 3 juli. En sekreterare ställs till respektive panels förfogande. Sekreteraren är med alla dagarna, skriver med stöd från panelen rapporten och gör slutredigering enligt panelens anvisningar.

Rapportmall

Panelerna kommer att få en rapportmall som underlag för rapporteringen.

Panelerna uppmanas att lyfta fram enskilda grupperingar som man anser gör särskilt värdefulla insatser och motivera dessa, dvs. peka på viktiga faktorer som leder till framgång. Viktigt är att också lyfta fram områden där kompetens/forskning/kommunikation saknas/är otillräcklig sett ur intressentsynpunkt.

1. Området i stort
2. Kriterierna 1-4 enligt bilaga 2 (panel I-IV) resp. bilaga 3 (panel V). För vart och ett anges goda exempel, vad som saknas/är otillräckligt samt framgångsfaktorer
3. Övriga synpunkter och kommentarer

Rapporternas användning

De enskilda rapporterna från nyttoutvärderingen kommer att göras tillgängliga inom SLU. Hela utvärderingen, Kvalitet och Nytta (KoN), dvs. såväl den vetenskapliga delen som nyttodelen kommer att slutredovisas i en rapport som skrivs av Projektgruppen för KoN. Avrapportering till SLU:s styrelse kommer att ske i november och slutsatserna kommer att ligga till grund för strategiska överväganden på olika nivåer.

Appendix 6 Units and programmes only included in the assessment of Impact and Utility

Centres and other activities with an outreach profile

UoA Code	Unit of Assessment (UoA)	Faculty
129-1	Omvärld Alnarp	LTJ
500-5	Fältforsk	NL
510-5	Agriwise	NL
550-5	LivsmedelsSverige	NL
595-6	Centrum för naturvägledning	NL
640-1	Movium - Centrum för stadens miljö	LTJ
895-1	Hippocampus	VH
973-1	SkogsSverige	S
977-1	Uppsala livsmedelscentrum (ULC)	NL
991-1	meNY (expertkompetens inom livsmedel - bioteknik)	---
991-2	Hästcentrum Skara	VH

Units with Foma operations

UoA Code	Unit of Assessment (UoA)	Faculty
200-1	Skoglig fältforskning	S
415-10	Viltskadecentrum	NL
911-1	Artdatabanken	NL
928-1	Centrum för kemiska bekämpningsmedel (CKB)	NL

Foma programmes

Skog (Forest)
Jordbrukslandskap (Agricultural Landscape)
Sjöar och vattendrag (Lakes and Watercourses)
Bebyggd miljö (Built Environment)
Övergödning (Eutrophication)
Försurning (Acidification)
Klimatpåverkan (Climate Impact)
Organiska risksubstanser och metaller (Organic Risk Substances and Metals)
Biologisk mångfald (Biodiversity)
Vilt (Wildlife)
Djurhälsa (Animal Health)

Appendix 7 Positive examples of Impact and Utility according to stakeholders

The list shows examples of projects and research areas/groups emphasized as good examples in the in-depth interviews and by the Stakeholder panels I-IV (shown in panel order and without ranking):

- *Plant Com Mistra*
- *Åtgärder för att minska övergödning och för att bevara den biologiska mångfalden i våra betesmarker*
- *Spannmål och dess funktionella kvalité*
- *Genetik och förädling av äppelsorter och havtorn*
- *Uppvärmning av växthus med hjälp av bioenergi*
- *Feromonforskningen*
- *Listeriaforskningen inom livsmedelshygien*
- *Jordbearbetning (bl.a. plöjningsfri odling)*
- *Genetik och avel på animaliesidan*
- *Mjölkprodukter – mikrobiologi - laktobaciller*
- *Livsmedelssäkerhet*
- *Gränsvärden för gifter*
- *Underlag för fjäderfälagstiftning*
- *Forskningen inom djurhälsa*
- *Djurskyddsområdet, spec. underlag för fjäderfälagstiftning, försöksdjur*
- *Smittskydd och smittsamma sjukdomar inom mjölkproduktionen*
- *Mjölkkoavel*
- *Inflammationsmarkörer vid ledbesvär hos häst*
- *Allergiforskning*
- *Hästnäringens ekonomiska betydelse*
- *Biomekanikforskningen*
- *Molekylär husdjursgenetik inom hundområdet*
- *Samarbetet med UU kring cancer*
- *Rennäringsfrågor/rovdjur (Öje Danell)*
- *Allt kring mjölkning*
- *Test av mjölkningsrobot*
- *Husdjurens utfodring*
- *Grisar, t.ex. avelsfrågan*
- *Riksskogstaxeringen med Hugin och Heureka*
- *Fjärranalysen (skoglig resurshushållning)*
- *Sydsvensk skogsforskning*
- *Enheten för skoglig fältforskning*
- *Institutionen för Skog-industri-marknad studier (Sims)*
- *Snytbaggeprogrammet*

- *Viltekologin (Kjell Danell)*
- *Naturvårdsbiologi (Lena Gustavsson)*
- *Mark- och vattensidan, såväl inom mark- som vattenforskningen (Peter Högberg, Kevin Bishop m.fl.)*
- *Skoglig mykologi och patologi (Jan Stenlid)*
- *Bioenergi (Per Anders Hansson m.fl)*
- *Entomologi (Stig Larsson)*
- *Bevattning med avloppsvatten och lustgasmätningar (Per Aronsson)*
- *DOM, MicroDrivE (Johan Schnürer)*
- *Teknisk rapsolja (Sten Stymne)*
- *Växtförädling på salix (Sara von Arnold)*
- *Framtidens skog*
- *SKA08 (Skogliga konsekvensanalyser med avverkningsberäkningar baserade på riksskogstaxeringen)*
- *Syntesrapporter kring energi*
- *Miljökonsekvensbedömning av skogsbränsleuttag*
- *Miljöanalysen om stubbar 2008 (Gustav Egnell)*
- *Informationsinsatser till berörda myndigheter kring biobränsle*
- *Samarbetet med Uppsala universitet och energicentrum kring bioenergi*
- *Tillämpad forskning kring insektsskador*
- *Skogliga konsekvensanalyserna och virkesbalanserna vid stormen Gudrun 2005*
- *Samverkan i internationella frågor, t.ex. tjänsteuppdrag i andra länder om skogsforskning/utbildning*
- *Växtgenetisk forskning tillsammans med Umeå universitet (Plant Science Center)*
- *Modern planteringsteknik*
- *Miljöpsykologi*
- *Miljökommunikation*
- *Multifunktionell design*
- *Friluftsforskning*
- *Förflyttningslandskapets utformning*
- *Gestaltning av det offentliga rummet*
- *Himlabacken, kombinerar landskapsvård med andra kulturyttringar*
- *Relationen mellan stad och land, och stadsnära lantbruk*
- *Grön rehabilitering*
- *Sambandet fattigdom, jordbrukares förutsättningar, internationell handel och klimathot (Ian Kristopolous)*
- *Rådgivning och kurser i allt från trädbeskärning till sjukdomar på träd och växter, mark och vegetation*
- *Plantering av träd i stadsmiljö, skelettjord*

Appendix 8 Photos of evaluation panels and the KoN Team

Scientific panel 1. Economics and Statistics
(from left to right): Carolyn Glynn (panel host), Bo Andersson (stakeholder), Anne Toppinen (Chairperson), Dieter Pelz, Jill McCluskey, Wolfgang Lentz, Alex Teterukovsky (stakeholder)

Scientific panel 2. Landscape Architecture, Urban and Rural Development
(from left to right): Christine Watson, Malene Hauxner (Chairperson), Anders Modig (stakeholder), Catharine Ward Thompson, Erland Eklund, Susan Senecah, Mark Francis, Carys Swanwick, Sven-Olof Bylund (panel host)

Scientific panel 3. Ecology and Environmental Sciences
(from left to right): Ola Jennersten (stakeholder), Ian Fleming, Mary Scholes, Mark Boyce (Chairperson), Martin Hermy, Johan Wallander (stakeholder), Helmut Segner, Michel Baguette, Staffan Wiktelius (panel host)

Scientific panel 4. Food Science and Safety
(from left to right): Lanfranco Conte, Jan Alexander, Liam Donnelly, Ragni Ofstad (Chairperson), Klas Hesselman (stakeholder), Hanno Korkeala, Ina Skanung (panel host)

Scientific panel 5. Animal Health
(from left to right): David Church, Richard Wall, Satu Pyörälä, Per Arnesson (stakeholder), Pia Haubro Andersen, Bernd Hoffmann, (Chairperson), Astrid Indrebö (stakeholder), Volker Moennig, Kristina Julin (panel host)

Scientific panel 6. Animal Husbandry
(from left to right): Ingrid Ragnarsdotter-Jajke (panel host), Erik Lindgren (stakeholder), Jessica Kathle (stakeholder), Eberhard von Borell, Werner Bessei, Patrick Kestemont, Ian Givens (Chairperson), E. W. Brascamp

Scientific panel 7. Biomedicine
(from left to right): Marianne Leukhardt (panel host), Bernard Charley, Rex A. Hess, Niklas Johansson (stakeholder), Johanna Fink-Gremmels (Chairperson), Henk P. Haagsman, Thor Landsverk, Henrik Holst (stakeholder)

Scientific panel 8. Forest Management and Products
(from left to right): Roger Asserståhl (stakeholder), Joao Pereira, Christoph Kleinn, Katia Ruel, Reino Pulkki (Chairperson), Annikki Mäkelä, Sven A. Svensson (stakeholder), Anna Rudebeck (panel host)

Scientific panel 9. Biosystems Technology
(from left to right): Kjell Brännäs (stakeholder), Richard Godwin, Antti Asikainen, Lars Tegnér (stakeholder), Jörg Hartung (Chairperson), Carl Blomgren (panel host)

Scientific panel 10. Plant Protection
(from left to right): Heikki Hokkanen, Bill Fry, Vibeke Bernson (stakeholder), Ola Kårén (stakeholder), Thomas Baker (Chairperson), Linda Kohn, Thomas Bruns, Lars Erik Lindell (panel host), Ring Cardé

Scientific panel 11. Plant Production
(from left to right): Anne-Charlotte Wallenhammar (stakeholder), Kevin Vessey, Karin Bennmarker (panel host), Friedhelm Taube, Stina Olofsson (stakeholder), Robert Graybosch, Stina-Lena Hellgren (panel host), Manfred Schenk, Michael Gooding (Chairperson)

Scientific panel 12. Soil and Aquatic Sciences
(from left to right): Peter Grace, Gunn Persson (stakeholder), Mark Hodson, Rickard Hooper, Roger Jones, Katja Lajtha (Chairperson), Claes Lundin (panel host), Anne Lyche Solheim (stakeholder)

Scientific panel 13. Plant Science
(from left to right): Vernonica Franklin-Tong, Chris Leaver (Chairperson), Elina Vapaavuori, Knute Nadelhoffer, Stine Tuvesson (stakeholder), Boel Sandskär (panel host), Robert D. Guy

Scientific panel 14. Genetics and Breeding
(from left to right): Dave Burt, Hans Stålhammar (stakeholder), Wolfgang Friedt (Chairperson), Steve McKeand, Wilf Keller, Lotta Hansson (panel host), Jules Janick, Hélène Lucas, Eero Nissilä (stakeholder)

Scientific panel 15. Chemistry, Molecular Biology and Microbiology
(from left to right): Christine Raines, Lars-Erik Nyström (stakeholder), Andrew Fisher, Tomas Lundqvist (stakeholder), Jarl Rosenholm, Ralph Conrad (Chairperson), Birgitta Höglund (panel host), Alfons Stams

Stakeholder panel I. Food ('Livsmedel')
(from left to right): Annika Åhnberg (Chairperson), Carl-Johan Lidén, Carolina Liljenstolpe (secretary), Lars Plym Forshell, Jan Rundqvist, Thomas Svaton, Ole Lind, Carl-Anders Helander, Eva Karin Hempel

Stakeholder panel II. Animal Health and Welfare ('Djurhälsa och djurvälfärd')
(from left to right): Göran Ask, Lennart Andersson (Chairperson), Karin Åhl, Jan-Åke Robertsson, Ulf Uddman, Peter Kallings, Ingrid Mossberg, Karl-Johan Petersson (secretary)

Stakeholder panel III. Raw Materials for Energy and Industry ('Energi- och industriråvaror') *(from left to right)*: Gustav Melin, Eva Pettersson, Erik Herland, Hanna Ericsson (secretary), Jan Gustafsson, Jan-Åke Lundén (Chairperson), Johan Wester

Stakeholder panel IV. Spatial Planning, Environment and Nature ('Samhällsplanering, miljö och natur') *(from left to right)*: Mårten Dunér (Chairperson), Fredrik Wallin, Frank Sterner (secretary), Börje Pettersson, Ulf Silvander, Katarina Schylberg, Jens Balsby Nielsen

Stakeholder panel V. Environmental Monitoring and Assessment, Foma ('Fortlöpande miljöanalys')
(from left to right): Magnus Fridh, Linda Berglund, Hans Oscarsson, Martin Sjödahl, Nils-Gunnar Lindqvist, Manuela Notter (Chairperson), Tomas Thuresson, Per Jennische (secretary)

The KoN Management Team
(from left to right): Elisabeth Rubbetoft (project administrator), Johan Schnürer (deputy director); Boel Åström (general coordinator), Katarina (Scientific panel coordinator), Roland von Bothmer (director), Per Andersson (Impact coordinator)

SUPPLEMENT

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