

Evaluation report 2008

Evaluation of JTI's R&D Activities 2005–2008



Evaluation report 2008

Evaluation of JTI's R&D Activities 2005–2008



Preface

The ongoing debate on the role of bio-fuel production in the increase in food prices and thus the emerging food crisis in poor countries, clearly stresses the decisive role of agriculture in sustainable global development. How could agriculture produce the required goods and services in an effective and sustainable way? Knowledge based on excellent and relevant research is urgently needed.

The evaluation of JTI, the Swedish Institute of Agricultural and Environmental Engineering, presented below is an important means of analysing whether the joint research investment by Formas and the private sector is used in the best possible way. The purpose of the evaluation was to scrutinize the scientific quality and the societal relevance of the research activities.

We are happy to note that the evaluation acknowledges some important strengths of JTI, e.g the relevance of its research, the highly appreciated dissemination activities and the frequent participation in international networks and projects. On the other hand the evaluation notes a negative trend in the extent of scientific publication. This may in the long run pose a threat for the organisation in terms of the quality assurance of research results and thus the credibility of the organisation. We expect JTI to find ways to change this trend.

Under the spending budget of the Ministry of Agriculture, Formas has earmarked money for research co-funded with the private sector. Formas has an agreement for the years 2005–2008 with private stakeholders organised in the Swedish Foundation for Agricultural and Environmental Engineering Research (SJMF) to fund equally 50 percent, i.e. 6.1 MSEK each, of the research framework programme of JTI.

Part of Formas responsibility is to evaluate the research funded by the council. According to the agreement between Formas and SJMF, the research under the present framework programme period should be assessed prior to the negotiations for the coming period.



Rolf Annerberg
Director General
Formas



Bengt Persson
Chairman of Board
SJMF

Mrs Caroline Trapp, former president of the Federation of Swedish Farmers (LRF), Professor Aad Jongebreur, earlier at Wageningen University and now president of the European Society of Agricultural Engineers, were appointed to conduct the evaluation. On behalf of Formas and the agricultural sector we express our sincere gratitude to the evaluators for their skilful work and very important contribution. We are convinced that JTI will, in the best possible way, give serious consideration to the wise recommendations put forward by the evaluation.

Rolf Annerberg
General Director
Formas

Bengt Persson
Chairman of Board
SJMF

Contents

Preface	5
Summary	9
1 Evaluation Process	11
2 Scientific Quality	13
2.1 Publications	13
2.2 Scientific competence	16
2.3 International position	18
3 Relevance of JTI's R&D	21
3.1 Customer satisfaction and orientation	21
3.2 Dissemination of available information	22
3.3 Conclusions	22
4 Research Strategy and Action Plan 2008	25
4.1 Research strategy	25
4.2 Action Plan 2008 and Framework Programme 2005–2008	27
4.3 Research: Applied or fundamental?	27
4.4 Base funding, stakeholders and commissions	28
5 Conclusions	33
6 Recommendations	37
Appendices	39
Appendix 1. Guidelines for evaluation	40
Appendix 2. Framework programme for JTI 2005–2008	44



Summary

The aim of the evaluation of the research and development activities of the Swedish Institute of Agricultural and Environmental Engineering was to assess their scientific quality and relevance.

The evaluation committee has reviewed the scientific quality on the basis of the following indicators: the scientific competence of the research staff, participation in international networks and projects and the number and quality of international publications and reports.

The presentations of the director, development manager and research managers and the discussions complemented with the written documents have given a good and broad picture of JTI. The relevance of the R&D carried out was judged on the basis of the presentations and discussions with the director and research staff and interviews with the chairman and stakeholders of SJMF and the Swedish Board for Agriculture.

In the evaluation by the committee the conditions for the research activities of JTI (e.g. financing and funding of projects, scale of the JTI, measures taken by the management) in the period 2004–2007 have played a role.

The strengths of JTI are the continuing building on the scientific competence of the research staff, participation in international networks and projects, implementation of modern technology in the research, building up new expertise (Bioenergy), flexibility in the period with less available project funding and the recognized relevance of the research and competences of JTI by the stakeholders.

Dissemination of the knowledge achieved from the framework programme 2005–2008 via reports, website, newsletters and the frequency of articles in the daily press work out positively for stakeholders, authorities, farmers' associations and the public debate in society. The output of peer reviewed

articles has decreased in comparison with the previous evaluation and forms a real concern. Improvements on this point must be a high priority for the management and the committee recommends a stepwise approach in the coming period.

The committee is positive about the progress made in the possible alliance with the Swedish University of Agricultural Sciences SLU and recommends a sensible and stepwise approach with emphasis on trust building. This alliance can strengthen the position of JTI and can improve the critical mass in specialist areas. For larger projects the committee recommends cooperation in the triangle SLU-JTI-industry (member SJMF).

Evaluation Process

The evaluation of JTI for the period 2005–2008 was carried out following the guidelines (Presented by Formas, Appendix 1). The major aim of the evaluation was to specify and establish the scientific quality and relevance of the research work of JTI within the present framework programme (FP 2005–2008). The evaluation should be carried out in an international perspective according to the most suitable procedures, taking into consideration the aspects and questions set out in the guidelines.

The evaluation committee comprised Mrs. Caroline Trapp from Sweden and Ir. Aad Jongebreur from the Netherlands.

Caroline Trapp was president of the Swedish Farmers' Organisation (LRF) in the period 2001–2005 and member of the board of the Swedish University of Agricultural Sciences, SLU, in the period 2005–2007. Today she is active in tourism and recreation combined with farming in Piteå.

Aad Jongebreur retired from Wageningen University and Research centre in 2006 and is currently president of the European Society of Agricultural Engineers for the period 2006–2008. He was director of the Institute of Agricultural and Environmental Engineering IMAG until the year 2002. In his career he has published quite a number of articles on research strategies for Agricultural and Biosystems Engineering and also on the emission of gases from animal production. He has been a member of several international evaluation committees.

For the evaluation committee, three meetings were organised, mainly in the office of JTI, Uppsala.

- March 12th, 2008 Kick off meeting with introductions in JTI and Formas.
- March 31st, 2008 Presentations of and interviews with research managers of JTI. Presentation of the cooperation SLU-JTI by Per Andersson. Discussion with the president of SJMF, Bengt Persson
- April 24–25th, 2008 Discussions and conclusions.

We are grateful for all information and support from the director and research staff of JTI and the management of Formas, especially from Hans-Örjan Nohrstedt.



Scientific Quality

The scientific quality of JTI in the period 2005–2008 is evaluated on the basis of international scientific publications, the scientific competence of the research staff and the international activities.

2.1 Publications

Especially in the Evaluation report 2001–2004, but also in JTI 's research strategy and the action plan for 2008, much emphasis is laid on the production of scientific, international publications.

The records are set out in Table 1.

Table 1. Number of scientific publications, peer reviewed international publications and conference papers, in the period 2003–2007

	2003	2004	2005	2006	2007
Scientific publications	34	34	24	11	24
Peer-reviewed	11	5	5	6	5
Conference papers	23	29	19	5	19
JTI reports	12	18	19	7	12 (targ.)
Patent applications	2	6	3	5	5
JTI “informs”		4	4	4	
Other publications			3	7	

Table 2 shows the distribution of the scientific publications among the specialist areas.

Table 2. Distribution of the number of scientific publications (peer reviewed publications + conference papers) among the specialist areas of JTI in the period 2004–2007.

Specialist area	2004	2005	2006	2007
Raw material and quality	4	4	2	12
Health and safety in agriculture	7	5	2	2
Livestock and plant nutrients	16	12	4	6
Systems for biological waste treatment	7	3	2	2
Energy			1	2

One of the recommendations in the Evaluation report on JTI's R&D activities 2001–2004 is to increase the publication of peer reviewed articles in order to improve the institute's visibility also in the international organisations. This is also necessary to realize the plan for more commissions from organisations like FAO, UNIDO and UNICEF (Action plan for 2008).

Concerning the peer reviewed international publications the record is around 0.5 per staff with Ph.D. per year. With regard to the total number of scientific publications (peer-reviewed and conference papers) there is a large decrease indicated in the year 2006. The annual average in the period 2004–2007 is 23 (against the average of 33 in the period 2001–2004) and that means an absolute decline of 30%. With an average research staff of 29.5 fte (full time equivalents), this means somewhat lower than 0.8 annual international publication per staff member. When the JTI reports are regarded as scientific publications the average is 1.25 per research staff man-year. The conclusion may be drawn that the number of scientific publications is far too low, with a very low number in the year 2006. The goal in the 1999 evaluation was set at 0.5 per scientific staff man-year (this means 14 peer reviewed publications per year). The previous evaluation for 2001–2004 stated that 45–50 articles per year should be more appropriate (p. 28).

Our conclusion is that the number of peer reviewed articles has declined substantially (average 5) in comparison with the period 2001–2004. This trend has to be changed in the right direction in the coming years. The number of conference papers has been at the same level and the number of JTI reports has substantially decreased by approx. 20%.

We make the following remarks and observations in connection with the publication activities.

- The standard performance of members of the Research schools of Wageningen University is one publication as first author and one publication as co-author per year.
- Internationally one can observe difficulties to meet the standard of two peer reviewed publications per year per scientific staff member (a good quality institute in the same research area in EU had approx. one peer reviewed publications per man-year over a three year period). This institute had more than 80% governmental financing*.

- The conclusion may be drawn that the moderate base funding in JTI and the increase in competition in the national and international funding of research proposals influences the publication activities significantly.
- The number of research staff has decreased by approx. 10%. The effect of critical mass on the publication activity must not be underestimated.

The following recommendations can be made.

- A first step to reach a minimum of one peer-reviewed publication as first author and one conference paper per staff member with Ph.D. and year must be made in the period of two years. A second step could be made to increase the number of peer reviewed articles to 15–20. We recommend that a feasible performance target is set up for peer reviewed articles. Our estimation is that for JTI the maximum is around 20 with the same number of research staff. The number of contributions to international conferences should be kept at the same level.
- Make a start to publish the JTI reports or a selection of the JTI reports also in English. This would also improve international visibility
- Scientific quality is more than the number of peer reviewed articles. However, we are absolutely convinced that their number must be raised. But scientific quality is also reflected in the contributions to international conferences (same level as previous period), participation in EU projects and in submitted EU proposals. The aspects of adequate research methods and techniques, and the flexibility of the research programme in relation to development in society and the needs of authorities and the scientific world are also important.

* Jahresberichte 2003–2005, Leibniz-Institut für Agrartechnik Potsdam-Bornim e.V.

2.2 Scientific competence

The educational background of the research staff is given in Table 3.

Table 3. Number of staff members of JTI in different categories during the period 2003–2007

	2003	2004	2005	2006	2007
Ph.D.	10	10	9	10	9
Agronomists	19	14	12	13	12
Engineers	6	8	7	11	11
Other background	20	11	10	11	14
Research staff (fte)	33	31	28.1	29.1	29.6
Total staff (fte)	43	39	35.6	36.3	37.4

The average number of employees with scientific duties in the period 2004–2008 is approx. 10% lower than in the year 2003. For the total number of staff employed by JTI, the decline is larger, approx. 13%. In the supporting areas of administration and information the decrease is higher than in the primary process of research.

The distribution of research staff over the specialist areas is as follows (data from the year 2008)

Table 4. Distribution of the different categories of numbers of research staff among the specialist areas (year 2008)

	PhD	MSc	Ph.D.student	BSc
Systems for biological waste treatment	2	5	1	1 (lic.)
Livestock and plant nutrients	3	6	1	3 (techn.)
Primary production and quality	3	5	1	
Bioenergy		3		1
Total	8	19	3	5

The number of staff with Ph.D. was somewhat lower than in the previous year (2007). If the number of Ph.D. students with MSc degrees is considered, it may be expected that the number of staff with Ph.D. will soon be at the same level as before, with some delay. We would like to stress their importance for JTI's expertise and the continuity of the institute. JTI must carefully guard its built-up expertise! The number of engineers among the scientific staff is increasing.



It is positive that JTI is continuing to invest in the post graduate training of staff in the subjects: 'Studies of the growth of *Penicillium verrucosum* and the production of ochratoxin A in cereal grain during anaerobic conditions' and 'the effect of housing systems and management on the survival of parasites in the animal environment'. Three post graduates are working on their dissertations and it a positive indication for a successful research cooperation and national and international recognition of JTI through publications in peer reviewed journals. An idea to consider for the future: should each specialist area have one Ph.D. student?

JTI has invested a substantial sum of money in the evaluation period in competence development and also the work climate, as shown by analysis of long term sickness data. Absence caused by illness is relatively low, < 2%. On the basis of the targets and results our conclusion is that JTI is professional also in this area.

The problem of critical mass of JTI as a whole and in the competences needed for the specialist working areas is of overall importance. Considering the different primary tasks of the organisations JTI and SLU, we conclude that the alliance between SLU and JTI is good for the position of the institute, for its division of tasks and specialisation.

We recommend that the competences and qualities of the research staff should be utilized in the contacts with stakeholders and elaboration of the alliance with SLU departments.

2.3 International activities

Activities are carried out to improve the international visibility of JTI especially to the UN organisations. For the EU, three project applications were submitted: MYCOREM, (Mycotoxin removal, reduction and elimination from the food chain, DENEREG (Sustainable Decentralised Energy Concepts based on Regional Renewable Resources and BIO-WAST (Managing the biodegradable fraction of municipal solid waste). The BIOWAST proposal has been rejected.

In 2005 JTI was the main organizer of the European conferences on Precision Agriculture and Precision Livestock farming. Also in 2005 JTI hosted a European workshop on the production of biogas. These activities improve the international visibility and position of JTI. JTI takes part in the

environmental projects around the Baltic: Adaptation of the EU Nitrate Directive in Latvia, and worked on the introduction of an ecosystem perspective into the use of marine, coastal and agricultural resources in the Baltic states, Poland and Russia. The project on Development of Sustainable Agriculture and Industry in Poland (DOSAIP) was completed. A project on grain drying is in progress.

Participation in networks with the Swedish University of Agricultural Sciences (SLU) and United Competence (UC) has taken place in order to improve the opportunities for being a partner in large projects. JTI was partner in the international networks on Anaerobic Digestion (AD-Nett II), Biomass fermentation towards usage in fuel cells (BFC), ENGAGE (European Network of Engineering for Agriculture and Environment), FAO/SREN network Promotion of knowledge sharing and international cooperation within the fields of environment and renewable energy, Mycotoxin Prevention Cluster in EU FP 5, RAMIRAN (Recycling Agricultural, Municipal and Industrial Residues in Agriculture network), EAGER (European agricultural gaseous emissions inventory researchers network and the Center for Environmental Farming Systems (CEFS , American Network).

JTI participated in 3 EU projects: Automatic Milking, Agroptigas, and OTA Prev (Prevention of Ochratoxin A in cereals).

The participation of JTI in international projects and networks is impressive, considering the amount of staff at JTI.



Relevance of JTI's R&D

3.1 Customer satisfaction and orientation

Thematic issues

The representatives interviewed expressed their high appreciation of the R&D work of JTI. Many customers pointed out that only JTI has the competence in their area of interest, e.g. waste management, agricultural engineering and work environment.

A remark which was often made among the interviewed persons is that JTI's R&D is too diversified (within the restricted budget) and that there is a need for more focus. But it was also much appreciated that JTI is flexible and can carry out projects in a broad field that are demanded by the stakeholders.

Influence of customers on the research plan

The stakeholders and customers were mostly satisfied with the contacts with JTI and also pointed out that:

- In the contribution fee there is a part that can be used for the partners' own projects, indeed this opportunity has been used and gives a very fast feedback to financing organizations.
- The collaboration with JTI offer an advantageous possibility to co-finance projects, e.g. JTI, industry and other financing together.
- In some bigger projects there has been a cooperation between industry, JTI and research departments from SLU. This has been working very well and seems to be a model which is worth to apply in more projects in future.
- In the short term, there are good possibilities to influence the research, with the exception of projects which are complicated to finance.
- On the other hand, several of those interviewed noted that, in the long term, the opportunities for closer cooperation between JTI staff and the industry, either in groups or individually, for setting up long term project ideas, were not always fully used in the period 2004–2008.

This point is in accord with the proposal in the Action Plan 2008: “to clarify the added values which stakeholder-ship confers on the existing stakeholders”.

3.2 Dissemination of available information

Research results and customers

The JTI reports, as well as newsletters and the JTI home page, were highly appreciated by customers. There has been progress since the last period in the area of the JTI home page and the frequency and content of newsletters. However, the targets for the number of JTI reports for customers have not been reached, probably because there were fewer projects than planned, and therefore less results to publish. The total number of JTI reports has also declined from the average of 21 per year during the previous period 2001–2004 to an average of 14 per year in the period 2004–2007 (see Table 1). The average number of popular articles is 19.

This might not be surprising when the total turnover has decreased; especially for the year 2005, the turnover was approx. 20 % lower than average. The interviewed stakeholders have not commented that too few JTI reports have been published. On the other hand, JTI has been very successful in reaching out with news to the media (more than one article/day in 2007). This function in the dissemination of facts and figures – related to the broad expertise of JTI – is very important. It makes agriculture and environmental technology in general and JTI in particular known and visible in the public debate from day to day.

Benefits of research results for customers

It is not easy to decide whether the customers benefit from the research results. The answers given vary from ‘yes’ to ‘probably yes’. Several of the stakeholders interviewed have given examples of good results, possible to use in practice. For specific projects, especially designed for the stakeholders, the benefits will be obvious. With effective communication, the more general knowledge is also likely to find users.

3.3 Conclusions

The evaluation of the relevance of the R&D work of JTI has been performed with input from JTI presentations, materials given by JTI, studying the home page of JTI and interviewing persons (total 11) representing different stakeholders (mostly members of SJMF).

Besides the adaptation of the research programme, against the background of the difficulties in finding sufficient funds for commissions and projects in the years 2004 and 2005, our impression is that there have been no substantial changes. Instead of the planned increase in turnover there has in fact been a stagnation in the number of activities. Those interviewed confirmed that although JTI expertise in the area of working environment is beyond dispute, funding for this area is difficult to obtain. They also stated that this specialist area is relevant.

Within the restricted budget the relevance and quality of the work is still high or very high according to our impression and the answers from stakeholders interviewed. The dissemination of available information of JTI's R&D is working very well.

The figures in the different documents presented clearly show an overall decline in the work of JTI during the latest period compared to the previous period. The turnover has decreased by average 7% but for the single year 2005 by approximately 20%, a figure that implies more than the amount in actual money. The number of staff working with R&D declined from an average 35 full time equivalents during the period 2001–2004 to 29 during the period 2005–2007.

Even if this trend slowed down in the year 2005 it is a remarkable change for an already rather small organization with several very different demands among their stakeholders. This underlines the vitality and flexibility of the organization.



Research Strategy and Action Plan 2008

4.1 Research strategy

Mission statement of JTI

JTI is an industrial research institute, i.e. a bridge builder between fundamental research, business (agriculture and environment related industry and producers) authorities (policy makers, decision makers, planning and licensing officers) and opinion leaders.

JTI conducts research and development work and provides knowledge based information in the areas of agricultural engineering and environmental technology. JTI's work gives companies, farmers, organisations and authorities the best available knowledge based information for their decision making processes, enhances competitiveness, and enables them to improve sustainability with special regard to the quality of the environment and the utilization of natural resources.

JTI focuses on the following specialist areas:

- Raw material production (primary production) and quality
- Livestock, manure and plant nutrients
- Health and safety in agriculture (Working environment and machinery)
- Systems for biological waste treatment
- Bioenergy

With regard to the area of health and safety in agriculture or in other words ergonomics and occupational health, the conclusion is that due to the lack of funds a change in focus can be determined. However in the Framework programme for JTI 2005–2008 the allocation for the area health and safety in agriculture amounts to 9%. The actual focus is more on prevention and reducing of accidents, and in future prevention of sickness might be a theme which insurance companies should have an interest in funding.

Bioenergy is already mentioned in the Framework programme under the heading: “development of new areas”. The conclusion is that JTI has been successful in developing expertise and competence in this new area into a specialist area in a

relatively short period. Participation in the EU application DENEREG may also be considered as recognition of JTI's expertise in this area. The conclusion may be drawn that in this special area the feeling of urgency within JTI is well developed.

The average distribution of the base funding among the specialist areas in the Framework programme for JTI 2005–2008 is given in Table 5.

Table 5. Summary of the allocations in the specialist areas in the framework programme for JTI 2005–2008 and 2004 in comparison with the average distribution of 70% of JTI's budget in the period 2005–2007 and the year 2007.

Specialist area	Allocations in the Frame work programme		Average distribution of 70% of JTI's Budget	
	2005–2008	2004	2005–2007	2007
Primary production and quality control	9	9	24	29
Livestock and plant nutrients	9	12	21	20
Systems for biological waste treatment	12	12	29	39
Health and safety/ working environment and off road machines	9	9	17	11
Development of new areas	21	17	n.a *	
International networks	5	9	n.a.*	
Scientific publication	5	4	n.a *	
Research information	11	9	n.a.*	

* not available

The figures in Framework programme 2005–2008 indicate that the specialist areas *Primary production and quality control*, *Systems for biological waste treatment* and *Health and safety in agriculture* are stable in the allocations, whereas the area *Livestock and plant nutrients* shows a significant decrease and *Development of new areas* (Bioenergy) indicates a significant increase in available budget in comparison with the 2004 situation. In the data of the distribution of approx. 70% of the total budget of JTI in the period 2005–2007 (document: Spread of allowances/assignments to the different research programs) the conclusion can be drawn that, taking into account the normal variation from year to year, the specialist areas of *Primary production and quality control* and *Systems for biological waste treatment* have a growth in the budget whereas *Livestock and plant nutrients* and *Health and safety in agriculture* indicate a shrinking budget. Especially for the last area the

reduction in the years 2006 and 2007 is relatively high, to approx. 10% in the year 2007 (was 31% in 2005).

4.2 Action Plan 2008 and Framework programme 2005–2008

The contents of the Action Plan for 2008, in comparison with the Framework programme 2005–2008, lead the following conclusions:

- the specialist areas and the main topics within these areas are in balance with the themes within agricultural and environmental engineering institutions in Europe and USA.
- healthy development in the direction of new areas e.g. Bioenergy
- a growing share of environmental technology (“environmental technology companies a potential as new SJMF stakeholders”)
- a decline in the share of Health and safety in agriculture/ Working environment and agricultural machinery due to lack of funds
- on the basis of presentations of research leaders and the topics mentioned in the annual reports of JTI the projects are well chosen and in accord with the needs of authorities, the farming community, industry and international organisations.

4.3 Research: Applied or fundamental?

In the mission statement of JTI it is stated: “JTI is a bridge builder between academia, business and authorities”. In discussions the question is often raised: Shouldn’t JTI carry out more strategic research or in other words is the character of JTI’s work not too applied? The boundaries between fundamental, strategic and applied research are today fading. More important is that the research work carried out is of high quality, utilizing the best available knowledge and methods. And in Europe innovation – bringing together science, technology and practice – is more important than ever before. That implies that within one project the typical university scientist works together with strategic and more applied research workers and also workers with practical experience.



For the future, we support the strategy for the search and realisation of alliances in order to increase critical mass. An alliance with SLU is logical and has, within JTI, an example in the close and successful cooperation with the Department of Microbiology of SLU and the recent formation of a centre of excellence “Waste Refinery”.

Some remarks of the evaluation committee.

- In the specialist area of livestock and plant nutrients in Europe the trend is to develop sustainable systems. Sustainable does mean an integral approach to design and model the standards on animal health and welfare, low emissions (emission of non-CO₂ greenhouse gases, ammonia, dust, odours) and energy and water use and economic indicators. With the well recognized expertise in the areas of sustainable nutrient management and biological waste treatment it is worth together with SLU departments to take the initiative, e.g. to start a project group.
- The topics on machinery and spraying equipment deserve more attention (see recommendation in Evaluation JTI 2001–2004). Competence and expertise development combined with alliances are necessary to play a role. Especially the use of plant protection chemicals accords well with more attention to environmental technology.
- Maintaining the unique expertise in the area of health and safety in agriculture/working environment and machinery is important for the future. It is sensible to focus today more on prevention and reduction of accidents and injuries and perhaps the prevention of occupation related sickness.

In the documents provided by JTI, the growing international competition for commissions and EU research grants is underlined as it was also stressed at the introductory meeting by director Lennart Nelson. For the coming period the most important challenge is to build an alliance with the Swedish University of Agricultural Sciences supported by the Boards of both institutions and authorities. We underline the importance and necessity of this alliance for the future of JTI.

4.4 Base funding, stakeholders and commissions

The number of stakeholders within SJMF has decreased in the period 2004–2007 from 55 to approx. 38 (target 2007).

This decrease has had limited influence on the total budget of commissions from stakeholders. JTI has taken measures to increase its attractiveness to stakeholders and to find new stakeholders and clients in the field of environmental technologies (Action Plan for 2008).

Development in yearly turnover

The average yearly turnover in the period 2004–2007 amounts to 28.9 M SEK, with a sharp decrease in the year 2005 to a turnover of 24.7 M SEK, due to the difficulties in funding from industry resources. The yearly turnover shows a slight increase, but the increase is significantly lower than the target set for the different years. Base funding from Formas and SJMF has increased in the evaluation period by approx. 13%. During 2004–2007 base funding comprised 40% of JTI's turnover.

A comparison of the base funding of JTI with two other institutions in this area:

- In the year 2006, base funding for the Applied research group “Plant and Environment” amounted to approx. 70% (Ministry of Agriculture, Nature and Food Quality 40% + 30% from Commodity Boards) with a yearly turnover of 41 M€ (part of Plant Sciences Group within Wageningen University and Research centre)*
- A well known R&D institute in the area of Agricultural and Environmental Engineering in Germany has achieved an average 18% of commissions, or in other words 82% of the budget was financed by the national and regional governments. This means that, in comparison with the above institutes in Europe – and maybe also with SLU – the base funding of JTI is still very moderate to low.

A remark can be made concerning the “base funding part” from SJMF which is used for projects, which, according to the definition of the financing of research, is not base funding.

The number of stakeholders – as already mentioned – is declining by approx. 30%. The breadth of the working areas of JTI is reflected in the breadth of the working fields of the members of SJMF. Especially for new developments it can be of value that the scoping studies or global surveys should be carried out as commissions from Formas.

Is limiting the breadth of the working area not better for the quality of the work delivered, in view of the fact that, from the standpoint of human resources, the delivering of quality must be the criterion? We have the opinion that focusing both the projects and commissions within the framework programme remains a necessity.

The other point is already mentioned in the action plan for 2008 that more stakeholders should be found in the environmental technology area.

Quite a large part of the budget must be earned in the form of commissions. So the conclusion is that JTI is very dependent on commissions from stakeholders and business.

* Yearbook 2006, Plant Sciences Group, p. 59, Wageningen UR



Conclusions

Our conclusions and recommendations are based upon the interviews made with stakeholders within SJMF, the chairman of the SJMF, deputy director of Formas, presentations of director, SLU (possibilities of alliance SLU-JTI) development manager, research managers and research staff members of JTI.

The evaluation 2005–2008 of JTI has taken place after a turbulent and rather difficult period in the disciplines of Agricultural and Environmental Engineering with e.g. the closing down of the Silsoe Research Institute (SRI) in the UK, the dividing of the Institute of Agricultural and Environmental Engineering (IMAG) in the Netherlands over the Plant Sciences Group, Animal Sciences Group and the Agro Food Sciences Group. Also by a decision taken by the German authorities to close down the Federal Agricultural Research Institute in Braunschweig-Völkenrode.

In addition, the adaptation of the research carried out internationally (mainly in Europe and USA) to conform to the trend in the direction of a move towards relatively more environmental technology themes and energy research. More generally, the need for more research linked to sustainable agriculture and complete chains (e.g. from Fork to Farm –EU programme) is internationally recognized. Against the background of these developments we draw the following conclusions.

- JTI has been successful in flexible adaptation of the framework research programme 2005–2008 with fine tuning with financiers and stakeholders. This appeared in the application of new research techniques with the unmanned plane (UAV) and use of sensors for oestrus detection, new research subjects on prevention and reduction of accidents, handbook for small slaughter houses, building up new expertise in the specialist area of bioenergy and the centre for excellence for waste refinery. JTI has implemented the international trends in research and has focused on the needs of financiers, stakeholders, authorities and society.

- In the first part of the period 2005–2008 financing of commissions and projects has been difficult, e.g. the decreasing funds for the specialist area Health and safety in agriculture/Working environment and machinery and the decrease in turnover in the year 2005 by 20 %. In comparison with the previous period, base funding was increased. In a period with good economy there is no problem but in a period with bad economy the somewhat complicated and mixed base funding from the government and industry can give rise to problems because the industrial stakeholders have not always enough funds for commissions, and when this is the case then also Formas is not able to give base funding above 3.6 M SEK (worst case scenario). We draw the conclusion that in comparison with some other institutes in Europe, the base funding of JTI is very moderate. In the evaluation period the annual turnover of JTI decreased by an average of 10 % in comparison with the previous period.
- The possible alliance with SLU is the major challenge for the coming period. We support this development in order to increase critical mass and to strengthen the position of JTI in the research market. The example of cooperation with the department of Microbiology has been successful for both sides, SLU and JTI.
- The number of peer reviewed articles decreased in the period 2004–2007, whereas the number of contributions to international conferences remained at the same level. An increase in the number of peer reviewed articles is a high-priority target for the management.
- Considering the small scale of JTI, the number of international activities is high, e.g. the participation in EU projects (3), participation in submitted EU proposals, participation in international Networks (FAO, UNECE), participation in international projects in eastern Europe, and the organisation of international conferences (2) and hosting activities. JTI is internationally visible.
- JTI is continuing to build up scientific competence in contracting three Ph.D. students and one within its own employees, in cooperation with universities. The number of engineers has increased within the research staff.

- Overall scientific quality of the research of JTI is sufficient to good, as judged from the basis of international participation in EU projects, participation in submitted EU proposals, participation in international networks, within EU, UNECE and adaptation of the framework programme 2005–2008 in view of research needs and funding,. The number of peer reviewed articles, considering the performance of other institutes in Europe, is too low.
- The relevance of the R&D work of JTI is good. The stakeholders interviewed are satisfied with the broad competence and expertise of JTI, as well as their possibility to influence research directions. Problems to find funding for the important field of working environment were pointed out. Those interviewed have benefited from the research carried out by JTI.



Recommendations

Peer reviewed articles and JTI reports

We recommend the management of JTI to improve the number of peer reviewed articles in the coming period of two years; according to the reference performances of other institutes and the moderate base funding it is a necessity to set a feasible target of approx. 15–22 articles for the coming four years. This issue is a high priority matter in the management agenda. Translation of JTI reports improves the international visibility of JTI.

Scientific expertise and competence

The framework programme for JTI is broad and this characterizes the diversified expertise available in JTI. For the coming period we recommend an integral approach in the topic of sustainable system development e.g. low emissions, animal health and welfare, low energy and water use. The expertise of spraying equipment for chemical substances related to the environmental aspects of drift and volatilization deserves space in the programme. Besides this, focusing within programme and projects from time to time is necessary. Increasing the number of research staff with Ph.D. above the present number may help JTI to increase the number of scientific articles.

Relevance of the research

Discussion with stakeholders indicates that cooperation on actual and urgent topics with stakeholders/companies should get a settled place on the agenda, e.g. cooperation in the triangle SLU-JTI-SJMF. We are impressed by the frequency of the articles in the daily press and recommends that participation in the public debate in society should continue. The ambition of strengthening the relations with the stakeholders in order to get a better insight into possible commissions and projects has our full support.

Alliance with SLU

Cooperation with the Swedish University of Agricultural Sciences (Alnarp, Skara, Uppsala) is not new for JTI, e.g. a long-term cooperation with the department of Microbiology

of SLU has been fruitful and gives the specialist area of *Systems for Biological treatment* a strong position. We support the cooperation SLU-JTI and advise a stepwise approach with much attention to trust building and the necessary skills for cooperation in projects among the research staff.

Appendices

Appendix 1. Guidelines for evaluation

Appendix 2. Framework programme for JTI 2005–2008

Guidelines for evaluation

Background and Aim

According to the agreement between Formas and The Foundation for Agricultural and Environmental Engineering Research (SJMF) the scientific quality and the societal relevance of the research within the present frame-work-programme (FP; 2005–2008) should be examined before the termination of the actual FP-period.

The main target of the evaluation is the research during the already passed first three years (2005–2007) of the FP, with appropriate retrospective links back into the previous FP (2003).

The research should be evaluated in an international perspective according to the most suitable procedures chosen by the evaluators after considering the aspects and questions raised below in the guidelines.

The actual evaluation will be a “light” version of the previous one, and should mainly be seen as a control of that things evolve in a positive way. JTI’s overall mission, research strategy and organisation should not be a matter of in-depth consideration. However, preliminary thoughts could be presented if possibilities for improvements are obvious.

Evaluators

The evaluation will be made by two experts, one representing the scientific perspective and one the stakeholder perspective. The scientist should be internationally well-awarded and active within relevant research fields (agricultural and environmental engineering). The stakeholder representative should have a central position in the sector with insight in present research needs of end-users. The scientist should be from outside Sweden. There should be no doubts as regards the impartiality of the two evaluators in relation to JTI. Serious measures should be taken so that there are one male and one female expert.

Issues to be assessed by the evaluators

The detailed performance and choice of tools and indicators in the evaluation should be the responsibility of the evaluators committed.

However, a recommendation is that the status and trends of scientific quality and relevance should be examined with respect to what is presented below. In the examination the applied nature of JTI's research should be considered.

- 1/ In short, how has JTI changed from 2003 to 2007 as regards research themes and size (volume funding and staff)?
- 2/ Have the activities of JTI during 2005–2007 thematically been in accordance with the FP?
- 3/ How have JTI's activities in total, per thematic field and per average scientist evolved quantitatively over time from 2003 (last year with data during previous evaluation) and onwards as regards the following?
 - Scientific publication in international journals with peer review
 - International conference proceedings
 - Popular written reports in Swedish for stakeholders
 - Articles and occurrences (e.g. interviews) in media (e.g. newspapers, radio, TV)
 - Documented oral dialog with stakeholders (e.g. courses, conferences, Web-visits)
 - Patents

Is the development positive and are the activities at a level which can be expected from an applied research institute of this type in an international comparison?

- 4/ How has the JTI's staff changed from 2003 and onwards?
 - Number of persons within different categories of staff
 - Number of PhDs in total and per thematic field
 - Number of staff in PhD studies

Is the development positive and is the composition of staff as can be expected from an applied research institute of this type in an international comparison?

- 5/ How have JTI's total external research co-operation qualitatively and quantitatively evolved from 2003 and onwards?
- National research co-operation with other institutes and with universities
 - International research co-operation

Is the development positive and is the external research co-operation at a level which can be expected from an applied research institute of this type in an international comparison?

- 6/ How has JTI's effectiveness (efforts and success) in retrieving external funding (Formas, SLF etc) in competition evolved from 2003 and onwards?

Is this effectiveness as can be expected for an applied research institute of this type in an international comparison?

- 7/ Are JTI's customers satisfied with the research?

- Is JTI working with the right thematic issues?
- Have JTI's customers possibilities to affect the research?
- Does JTI effectively make research results available for customers?
- Do results from JTI cause a real beneficial change for customers?
- If possible to give a reliable answer – have things changed from 2003?

- 8/ Have the main recommendations from the previous evaluation been largely implemented?

- 9/ Which are the most important recommendations to JTI for the years to come? Which strengths could be better utilized? What weaknesses should be corrected?

Material supporting the evaluation

JTI should make the following material in English available for the evaluators:

- General description of JTI (facilitating question 1)
- Framework program (facilitating question 2)
- Annual reports 2005–2007 and/or a summary of these (facilitating question 2)
- Tables and/or descriptions giving data for activities, staff, external co-operation and funding (facilitating questions 3–6) – annual data should be presented in total, per thematic field and per average scientist

- Individual CV and publication list for every scientist
- A short self-evaluation by JTI answering questions 2–8 (max 3 pages)

Most material should be available for the evaluators at the Kick-off meeting.

Time schedule – preliminary meetings and final report

The evaluation should start as soon as possible in 2008 with a one-day kick-off meeting (12 March agreed). In the first part of this meeting representatives from Formas, SJMF and JTI should participate to explain and discuss the aim and frame of the evaluation and to support with material and information. The second part of the meeting should be for the evaluators alone.

Supporting material is studied by the evaluators after the kick-off meeting and before the following intermediate meeting.

An intermediate one-day meeting will take place in late March (31 March agreed). At this meeting the evaluators will have possibilities to meet and raise questions to JTI's Executive Director, research directors and program leaders.

A final 2-day-meeting is planned for in April (24–25 April agreed). The first day is intended for the evaluators to finish writing the preliminary report and to conclude. The second day is for the evaluators to present main findings for Formas, SJMF and JTI, followed by a discussion to clarify possible misunderstandings. The preliminary report is made available for Formas, SJMF and JTI at this meeting.

Between the meetings described above the evaluators read, think, make the necessary stakeholder interviews/enquires, and writes the preliminary report.

Framework programme for JTI 2005–2008

Introduction

In order to provide long term guidance for those parts of the work of JTI which are jointly financed by Formas and SJMF (Foundation for Agricultural and Environmental Engineering Research), a framework programme is negotiated every four years. The aim of the framework programme is to identify the r&d areas to which JTI shall accord priority, and to direct other key activities so that JTI can, in the long term, deliver what the target groups demand. The target groups of JTI are companies and authorities engaged in the areas agricultural and environmental engineering and construction plant. The companies in SJMF are able to exert an influence on the focus and priorities of the framework programme, and they are also charged for commissions carried out by JTI at reduced rates, according to a separate agreement.

The budgeted turnover of JTI for 2004 is MSEK 30.7. Turnover figures during the present framework agreement term (2001–2004) were MSEK 31.7 (2001), 29.8 (2002) and 31.1 (2003), i.e. largely unchanged. The agreed funding of the framework programme for the period was MSEK 5.1 from Formas and a similar sum from SJMF, i.e. a total of MSEK 10.2. Contributions have increased from year to year, and amount to MSEK 5.4 in 2004. In other words, funding of the framework programme is just over 30 % of JTI's turnover.

Continued funding of the framework programme, at the same level as for the period 2001–2004, i.e. MSEK 5.1, is considered by both JTI and the international evaluation group to be a minimum (this should however be adjusted upward using the AKI labour cost index for salaried employees, i.e. to MSEK 5.8). It is then probable that the current activity can be maintained, but it is unlikely that it can be expanded. After each special area, a proposal is made for the allocation from the framework programme budget. This sets out allocation at reduced, present and increased level. The present level refers to MSEK 5.8 and the increased level to an increase by MSEK 3.3 from Formas (the starting point is MSEK 2.9, the increase

the parties agreed on to aim for in the current agreement, adjusted by the index), i.e. a total of MSEK 9.1 and the same sum from SJMF.

The following are some of the documents used as the basis for the draft framework programme:

- JTI's action plan for 2004 – external and internal versions
- Trend analysis and future scenarios (page 50)
- JTI's targets for 2004–2008 (page 60)
- Report from Panel of Experts for evaluation of JTI
- Position Paper – Feedback from JTI

Restructuring

In agriculture, the pace of structural rationalisation towards fewer and larger units is increasing, with increasing international pressure on prices. In the field of environmental technology Swedish exports are increasing, and through an expanded EU international cooperation is broadened.

Competition for research funds has increased both nationally and internationally, and at the same time the trend is towards funding of programme areas of increasing size which encompass networks of researchers from several countries and environments. This makes it necessary for the players to have focus and a critical mass. All in all, the result is that JTI is facing a future that will bring about large changes in our work, since JTI is a small research institute with just under 40 research staff (2004). Many other industrial research institutes in Sweden are merging/have merged with, primarily, other institutes. JTI is also discussing a future restructuring which may entail partnership with SLU and/or Nordic sister institutes and/or a merger with an appropriate partner or partners (SP/SIK), even though JTI has not progressed as far in this matter as other institutes.

Our specialist areas

In order to improve our chances of satisfying future requirements, JTI has decided on the eve of 2004 to highlight four specialist areas where JTI is far in advance on the research front and has a high degree of expertise. This grouping is largely the same as that proposed by the international evaluation group. Before 2005, we intend to continue focusing on the specialist areas, and we also consider that the framework programme should focus on these areas. They are:

- *Control of quality and production*
- *Livestock, environment and production*
- *Health and safety in agriculture*
- *Systems for biological treatment of waste*

Draft framework programme

Inputs should concentrate on developing methods and investing in equipment and new research areas. The guiding lights for these efforts are “sustainable systems” and “multi-disciplinary r&d”.

Development of networks and contacts, nationally and internationally, is of increasing significance in the internationalisation that is taking place regarding both project finance and research and development. For JTI this has high priority, and “International net-works” therefore has a separate heading in the table which summarises allocations on the last page of this document.

The Board should continue to have the opportunity to prioritise certain inputs every year.

Directing quality and production

In order to meet the increasing demands that farmers face as production units are becoming larger and at the same time the requirements for safety and control in production increase, technical solutions or systems (for example sensors) must be developed to improve the profitability of agricultural enterprises. The sensors must be cheap, and in most cases they need adjustment to fit into the demanding environment they will be used in. JTI is focusing on this task and on developing entire systems in which the sensors will work. Traditional measuring technology is combined with sensors to control and secure raw material production in agriculture. The objective of JTI with this specialist area is to establish a sensor centre for agriculture. To be able to do this. JTI must invest in appropriate equipment and expertise, and must upgrade a number of localities.

Livestock, environment and production

JTI is working with the traditional production livestock of agriculture, but also with horses which are largely used for recreation at present. The starting point is development of economically justifiable systems and solutions which take both livestock and the environment into consideration at the same time. In this way we will have long term sustainable livestock production.

The work focuses on developing production systems to improve the welfare (health and behaviour) of livestock, to optimise system solutions for livestock husbandry also with regard to working environment and the external environment, and to develop systems for sustainable utilisation of plant nutrients in organic manures. JTI is also focusing on the hygienic quality of milk raw material. In 2003, JTI invested in a test facility which was installed directly adjacent to a milking parlour, where it is possible to study the influence of the washing-up process on the hygienic quality of the milk raw material, make tests on washing-up liquids, and develop sensors for milk production.

Systems for rational and environmentally correct management of farmyard manure are a traditional field for JTI. The focus today is to minimise the loss of plant nutrients, e.g. in the form of ammonia emissions, and to achieve a high utilisation of plant nutrients. JTI is therefore engaged on determining the nutrient content of chicken manure at various producers, developing a shallow injection tine, with little need for traction, for liquid manure, and developing a strategy for the management of green manure leys.

During the next programme period we will strengthen our position concerning livestock husbandry outdoors, issues to do with farmyard manure for units of increasing size, and returning plant nutrients from the community to agriculture.

Health and safety in agriculture

Working environmental conditions (health and safety) in the fields of agricultural engineering and environmental technology must be improved, but for a long time they have had low priority. At present and in the future, it will become more and more difficult to attract labour to agriculture, and this is therefore a very important issue. Issues to do with labour organisation will also be increasingly important as the size of farms increases. At present, JTI is conducting research in the principal areas working environment in driver's cabs, climatic ergonomics, noise in agriculture and screening of working environment in agriculture (WEST method – Working Environment Screening Tool). The WEST method has great potential for JTI since there is no other similar scientific method available for agriculture. JTI has started to adapt the method to agriculture, since it was developed for the engineering industry. The method has been found very easy to use

in agriculture. JTI has invested in a database which has been coupled to the method, in order that a large body of material should be available in the future to serve as a basis of comparison and the working environment should be evaluated also with regard to the economic aspect. This method will be important for JTI in future, and further development of this is therefore proposed.

Systems for, and biological treatment of, waste

The environmental technology JTI is working on usually has couplings to agriculture in some form. JTI can further strengthen the area of environmental technology, and can in this way also work with several customers in the area, such as municipalities, municipal and private companies. JTI has unique facilities, with agricultural engineering and environmental technology know-how in good combination. JTI is working on methods for the treatment of organic waste, sewage effluent and farmyard manure, both in laboratory and pilot experiments and at full scale. The long term goal of JTI is to create the conditions, through a combination of research oriented and applied activity, for the establishment of treatment and handling systems for organic waste and other biomasses. The strengths of JTI lie in the areas anaerobic treatment and production of biogas from organic materials, and systems for the treatment of sewage effluent from individual households. Most of all, it focuses on technology that enables the return of plant nutrients from the community to agriculture.

JTI has worked on system analysis and decision support systems for several years, with the intention to develop data on which decisions can be based in waste and sewage treatment. A computer based tool (Organic Waste Research - ORWARE) is used, inter alia, for the evaluation of various treatment options for waste, and also for the calculation of the environmental effects due to e.g. the production of renewable fuels for vehicles.

During the next framework programme period, we intend to enhance JTI's ability to assess the aerobic and anaerobic convertibility of various materials (e.g. waste and biomass) and thus their suitability for different treatment methods. It is also our intention to develop the ORWARE model so that the tool may be used commercially.

Scientific publication

In a long term perspective, it is essential that JTI's research should be published in international scientific journals, both to maintain and expand JTI's international contact networks and to have a guarantee that its high scientific quality is maintained.

Research information

JTI publicises its r&d results through national publication of reports and by popularising the results via the mass media, printed matter, fairs and the internet. JTI has good competence and a long experience in actively popularising and promulgating the results of its r&d activity. This must be continued through the development of online publications and print-on-demand treatment of report series.

Development of new areas

The international evaluation group emphasises that VTI must create new “programmes” of great future research and development potential. The term “programme” in this context refers to a research area which will be associated with JTI. One of the specialist areas of JTI, Bioenergy/Renewable Energy, is such a new area which JTI intends to try to develop. Another development area is the system effect of the new economic conditions which the “new CAP” gives rise to, and their impact on e.g. technological requirements, sustainability perspectives, etc. The intention is that “programme creation” should take place in stages, with an introductory investigation and analysis phase, which, if the outcome is favourable, would be followed by an implementation phase.

Summary of the allocations

Area	Present level %	Increased level %
Control of quality and production	9	9
Livestock, environment and production	12	9
Health and safety in agriculture	9	9
Systems for biological treatment of waste	12	12
Scientific publication	4	5
Research information	9	11
Development of new areas	17	21
International networks	9	5
Development of capability	10	10
For the annual priority work of the Board	9	9

Trend analysis and future scenarios

Approved by the JTI Board on 27-05-2004

Technical trends in agriculture

The technical trends for primary production which were identified during the review of “Technical Foresight”, such as sensor technology and information technology, still largely apply. These can be effectivised in agriculture. Cultivation can be carried out with greater precision and with a lower labour input. Administration and transport can be made more efficient and finishing processes can be automated and made safer. However, to a greater extent than is apparent in “Technical Foresight”, it is likely that biotechnology, in the broad sense of the term, will have an impact on agriculture, primarily through the new applications which it enables. Biotechnology is much more than just GMO and it probably has the potential to open up a number of new applications for many areas, e.g. plant protection, fertilisers and processing.

Political trends and decisions

In the EU, the consumer perspective with regard to food production is increasingly highlighted at the expense of perspectives which only favour the industry. The global increase in obesity and measures against this are one example where social aspects and consumer perspectives are contrary to certain industrial interests. At the same time, there are other industrial interests which quickly catch on to proposed measures and exploit these. Another example of consumer reaction is the “slow food” movement which can be seen as a reaction against “fast food”.

Work on globally sustainable development is still on the agenda even though the conflict with short sighted economic growth is increasingly evident. Both globally and nationally, large resources are channelled into rural development which is often interwoven with agricultural development.

The issue of climate will probably have increasing significance for political decisions in future, while environmental issues are increasingly part of everyday politics and have been downgraded. The arena for environmental issues is becoming more and more global, and this is further reinforced by the movement of base production to low-wage countries. The relative environmental impacts in Europe of

products and the service sector, and energy production and the transport sector, are increasing while the environmental impact of industry is decreasing.

The economy, growth and competitiveness are prioritised areas. The EU is increasingly gearing up to cope with the competition from the US and the emerging regions of growth in Asia and elsewhere.

Some important trends and decisions that set the standard for all national and international activity are listed below.

- **Globally**

- WTO negotiations where e.g. the embargo on strikes and lockouts ends. Export subsidies will also be abolished eventually.
- Increasingly stringent control to increase the use of renewable energy raw materials, in which respect the Kyoto Protocol and the issue of climate are decisive arguments.
- UN accords priority to the development of food production and rural areas in developing countries, i.e. small scale approach. The need exists for the combination of biology, technology and local conditions into successful practical solutions. Funding is on the whole local. The technical applications primarily consist of adaptations to existing techniques.
- Sustainable development and Agenda 21.

- **EU**

- The new EU agricultural reform results in decoupling of subsidies from production.
- EU has been enlarged and efforts are directed towards the new member countries.
- Production in the EU countries is expected to be lower. The framework directive for water is being implemented. This is a far reaching reform that requires coordination among regions and countries and will be the driving force for environmental measures.
- Definition of when a raw material is classified as food is moved from industry to the farm. Deliveries to the farm are also affected. This comes into force in 2006 or 2007.
- There are targets for the proportion of biofuel in total energy production (12% in 2010).
- The transport sector (incl. car traffic) is facing changes: reduced emissions, environmental charges, a higher proportion of rail and shipping.

- **Sweden**

- Environmental quality goals have been decided on by the Riksdag. These set out the ambition which is then translated into legislation, licensing decisions, economic instruments, etc.
- Prioritisation of sustainable growth and production in society.
- Open landscapes (preservation of grassland).
- Local production for economic policy reasons.
- Quality assurance of both handling and product.
- Landfilling of organic waste prohibited from 2005.
- Targets for recycling phosphorus (to be announced) and certain kinds of waste (e.g. in 2010, 35% of food waste must be recycled instead of being taken to landfill or incinerated). Requires a holistic approach, inter alia to devise properly working systems for recycling to agriculture. Recycling is, however, often questioned.
- The Recycling Bill in which one of the issues highlighted is waste management.
- A tax on incineration of waste is under investigation, and it is very likely that a tax will be introduced.

Trends in general

Some general trends which are considered to have an effect on the work of JTI are set out below. In certain cases these trends may be contradictory.

- **Structural rationalisation**

- Agriculture: Structural rationalisation in the industrialised countries is proceeding at a very fast pace towards units of increasing size. Dairy farms for fewer than 1000 cows are not established in the US. In Denmark the level is over 100 cows. Development is driven by “price”. What is regarded as large depends, inter alia, on conditions in the countries.
- Industry: The Swedish and European food industry is rapidly moving towards a market that is subject to increasing price competition. As regards research and development carried on by industry, there is a focus on areas of competition of strategic importance for the company concerned where they want/have to be “best in the world”. Development in other areas that are still important for the company occurs through outsourcing. This makes for speed and flexibility.
- Trade marks of the type Lidl, ICA, i.e. company trade marks, are increasing both in numbers and significance.

- **Internationalisation**

- (Bulk) production of food is an international commodity, i.e. a development that is driven by price competition.
- The processing and distribution chains are international, while the production side (primary production) is national.
- There is increasing specialisation where one manufacturer often supplies many distributors. There is much more outsourcing.
- Price competition, with lower margins, which results in companies minimising their risks and concentrating on concepts that have been fully developed.

- **Production**

- Quality assurance of both handling and production.
- Added value and functionality, which also encompasses quality aspects. In order to counter the pressure on prices, companies endeavour to create added value that must be protected. Companies are less willing to take risks, and want to protect/keep strategic partners in order to secure unique values.
- Increased interest from the political sphere (Kyoto Protocol and the issue of climate) and from industry for zero emissions in energy conversion, e.g. for engines.
- There is development potential in further refining agricultural raw materials and utilising everything – such as in the case of crude oil where everything is made use of and processed at very large scale. This results in a relatively low price for refined products.
- The functional food segment is getting larger, and development of both techniques and raw materials will occur in association with e.g. biotechnology.

- **Holistic approach** – man, animal, technology, society.

The perspective is quality and not quantity.

- The “Green Sector” is in a unique situation as regards a holistic approach. The entire chain from production to town/community and recycling to agriculture is part of this sector.
- Sustainable production – a strong political goal where the question is no longer if but when. This, in turn, increases the importance of a holistic approach – the chain land/table/land – which is unique to the Green Sector.
- Price is the driving force. Niche production is not free from competition.

- **Bioenergy**
 - The importance of this, for global reduction of climatic effects and dependence on oil, will rapidly increase.
 - Because of higher oil prices, other options will become commercially attractive.
 - Formulation of an energy tax system will be a key factor for profitability.

- **Biological waste treatment** – there is a system of controls to stimulate this. New plants are constructed. At the same time, the waste management industry is building up a considerably greater capacity for the incineration of waste, inter alia organic waste.
 - Renewable fuels – the biogas process has the potential to deliver fuel today and probably also to a future society where hydrogen gas is the principal renewable fuel.
 - A developed infrastructure for natural gas accelerates the use of biogas in vehicles.

- **Recycling of phosphorus** – It is likely that national targets and possibly also financial inducements will be introduced to stimulate recycling from e.g. sewage.

Research and development trends

Trends in r&d which impact on the environment JTI is working in are listed below.

- **R&d**
 - Applied research is sidelined in favour of basic research.
 - Swedish Farmers' Foundation for Agricultural Research SLF funds applied, need related research and development.
 - The way from basic to applied research will become quicker.
 - Growth issues, innovations are important.
 - Restructuring of institutes.
 - Sweden focuses to a considerably higher degree than the rest of EU on basic research.
 - Innovation systems are important.
 - An EU Research Council.
 - The aim of the sixth EU framework programme is to restructure research – increased European collaboration, stimulation of inventions, etc.
 - The Nordic Region is an internationally competitive research arena.
 - The sectorial role of Swedish University of Agricultural Sciences SLU will change – towards an increasing focus

on natural sciences and basic research where funding is more secure.

- Research and competence are international, while recruitment is in most cases local.
- Virtual RDD (Research, Development and Demonstration) centres and centres of excellence.

- **Biotechnology and nanotechnology** (including GMO) is a subject of investment by society. In these areas r&d receives a relatively large amount of finance from the State. There is however a contrast between “political” statements and what is happening in biotechnology. The pace of development is not what was predicted 5–10 years ago. Important breakthroughs have been achieved within GMO, but the marketing success, at least in Europe, has not materialised. GMO is under strong political control, and once the conditions have been clarified, development will have a clearer direction. However, biotechnology comprises considerably more than GMO, and significant development of its application in the agricultural sector, outside the GMO area, is probable. It is not clear what the need will be for development in the field of engineering (engineering physics). It is however likely that the trend will be towards sensor and decision support systems rather than towards traditional agricultural engineering.
- **Decision support systems for MMI** (Man Machine Interaction) – technology that makes technology user friendly, i.e. dispenses with the need for special expertise. It also encompasses the correct solutions which improve the chances of attracting and keeping staff.
- **Fuel cells and hydrogen gas** are predicted to become a replacement for petrol and diesel for vehicle propulsion over a longer perspective. There is great investment by both the automotive industry and public research funding agencies. Agriculture has the potential to supply energy raw materials for certain system solutions.
- The interest in **animals for sport and as pets**, inter alia horses for racing and riding horses, is already large and is growing. There is also increasing interest in golf. This may change the way in which certain parts of the green space are used.

- In **waste management and sewerage**, there is a potential for development of technology and systems, inter alia within quality assurance, biogas, closing down of landfill sites and small scale sewerage technology.

Future scenarios – agricultural engineering

In view of the trends described above, three future scenarios for agricultural engineering have been identified for the work of JTI. These scenarios are based on the following reasoning: the size of farms is growing at an increasing pace in response to strong international price competition. On these farms there is high competence and they concentrate on food production. At the same time there is a political intention to retain a flourishing countryside and a cultural landscape in large parts of the country. This can, for example, be accomplished through various forms of support, sources of additional income outside food production or by developments on the farm – in other words a multifunctional agriculture. Rational units that are run profitably are common to both these future scenarios.

Another category comprises the countries in a phase of development into industrialised countries which mainly produce for their own needs or for a local market. Here, there is great need for knowledge and technology suitable for smaller units. The focus is on food production.

Future scenarios relating to environmental technologies are in some agreement with those relating to agricultural engineering, but in the case of environmental technologies political decisions are the critical driving force. A higher proportion of renewable energy and bioenergy in the future, as well as the prohibition of landfilling organic waste, are the strongest driving forces. The capability of agriculture to produce bioenergy to a greater extent than today, and to recirculate plant nutrients from society, are niches for multifunctional agriculture.

1) Large scale production agriculture which produces at world market prices

Large scale production agriculture units are located in geographical areas that are favourable for what they focus on. They work in an international market which is fully controlled by the requirements of customers, and are subject to international price competition. Full price competition will prevail when protective tariffs and subsidies are abolished.

Legal requirements are complied with, but further commitments are made only when these are economically justifiable.

These units are technology intensive and in constant need of rationalisation and development. It must be noted that technology is obviously needed for rational operation, but also to create attractive environments for the necessary labour. The ability to attract competent labour, and facilities for further training, may be of critical importance.

The needs of these units will set the direction for applied agricultural development and also, to some extent, research.

Key technology industries focus their development resources in the areas where they must be among the best in the world to be successful. Collaboration/alliances with external r&d partners is possible during the early stages of the development phase, but these are rare and temporary as development approaches finished products/concepts. For the areas that are situated outside the key technology sphere, development will most probably occur through alliances and/or outsourcing.

II) Production agriculture with complementary activities – units primarily in Europe

The conditions for farms are greatly dependent on political decisions, examples of which are support systems. Food production in bulk that is run rationally on the basis of geographical and political conditions is normally the basic activity, complemented by some other activity to create the best possible profitability. The complementary activity is found within a broad spectrum, with e.g. added values such as a flourishing country-side and a cultural landscape, and the term multifunctional agriculture is a good illustration of this. There are however farms where the complementary activity is the driving force and the “normal” agricultural production is the complement. There are also units for niche production. The large scale production units are often defined by their size, but most of all by the fact that the activity necessitates a complement to be profitable.

The large technological trends are not promoted by these units, but rather through a transfer and adaptation of the breakthroughs made by the large scale production agriculture. On the other hand, there is technological development on a more detailed level also for production agriculture with

complementary activities. There is a great need for enhancement of capability and development, which is often financed by public funds.

III) Smaller units – countries in the development phase towards industrialisation. Focus on food production

Eighty per cent of the world's population lives in developing countries where food on the table is not always a matter of course. These countries are in great need of increasing domestic production of food which, on its own, necessitates technology adapted to local conditions (biology, economics, structural rationalisation, ownership conditions, etc). Technical development primarily comprises applicational solutions in which existing technology is made use of. It is important to note that there is very probably no interest in antiquated technology from the industrialised world.

There are couplings to aid and other forms of international support.

Initially, most units will be on a small scale. It is however only a matter of time before these become larger units that compete in an international market.

“Consequences” for JTI

The scenarios below are set out in isolation for the sake of clarity. Under realistic conditions, there will obviously be mixtures of these.

I) Large scale production agriculture which produces at world market prices	II) Production agriculture with complementary activities – units mainly in Europe	III) Smaller units – countries in the development phase towards industrialisation. Focus on food production
<p>JTI must be “best” in a few areas which are closely associated</p> <p>JTI must have competence in, and experience of, units that are large in an international perspective</p> <p>Alliances based on competitive competence</p> <p>The work and clients (e.g. funding) must have a strong international stamp</p> <p>Play safe—there is little money available for risky ventures</p> <p>Technology oriented</p> <p>Demands cooperation with international r&d environments working in associated areas to achieve credibility and size</p> <p>Demands modern equipment which is continually renewed</p> <p>Need for evaluated new/modern technology</p> <p>Strong coupling to industry</p> <p>Environmental impact and system approach of critical importance</p> <p>Environmental legislation determines standard</p>	<p>Demands breadth of competence</p> <p>JTI must have competence in, and experience of, production units that are large in a Swedish and to some extent European perspective</p> <p>Technology oriented</p> <p>Good contacts with funds/ funding agencies for development</p> <p>Close cooperation with the authorities and political bodies</p> <p>Broad composition of stakeholders</p> <p>Projects national or specific to a certain country/conditions (probably Europe), and necessitate local partners outside Sweden</p> <p>Demands competence regarding legislation and policy</p> <p>Demands cooperation with similar environments, primarily in Europe</p> <p>Environmental impact and system approach of critical importance</p>	<p>Demands breadth of competence</p> <p>Internationally marketable competence</p> <p>Strong coupling to industry</p> <p>Competence with international experience needed</p> <p>Technology oriented</p> <p>Contacts with local sources of finance</p> <p>Environmental impact and a system approach of critical importance</p>

JTI's targets for the period 2004–2008

Background

The Institute's special role within the innovation system places particular demands on target setting and evaluation of the organisation's quantity, quality and efficiency. The coming 4-year period is difficult to assess due to the scale of changes occurring in the world around us. It should therefore be noted that the formulation of the targets is based on the present status and does not consider the various scenarios which might arise in the short or long term. Additionally, this is the first year that a document is being presented with formalised targets. The document should therefore be developed further in 2005.

An analysis of the current status indicates that JTI will, to a much greater degree than today, be exposed to a competitive international market. To meet this JTI is working, in accordance with the Board's decision, toward building alliances with Nordic sister institutes, with the intention, not only of broadening the scope of activities but also of generating a greater volume of research. If this venture does not show concrete results during 2004, other potential alliances should be considered – Swedish and international.

JTI's overall aim with this document is to promote a clear goal-oriented direction and evaluation of activities. In order to facilitate this, suitable indicators have been defined below. These indicators are measurable, and in most cases, historical comparisons can be made, which helps set realistic targets.

Financial targets

Turnover

The level of turnover is heavily dependent on the agreement which is reached between SJMF and Formas. Eventual increases in this amount are not taken into consideration in this document. An increased turnover is to be achieved through increased research grants and assignments.

Turnover has increased from 27.1 MSEK in 1997 to approximately 30 MSEK. The aim is to increase the annual turnover from 1.5% in the beginning of the period to 1.75% at the end, inflation effects not included.

Profit

Starting with 2004, the target is set for a profit of 2% of turnover. The profit can be disposed of, either in order to achieve solidity and consolidation targets which have been established or through investments in the Institute, such as for equipment or for extraordinary expenditure. As has been made apparent to the Board and from Formas' most recent evaluation, there is a substantial need for new investment in relevant new or updated equipment and premises. We are thus going to evaluate these needs for refurbishment of premises and investment in equipment during 2004 and carry these out by 2008. We intend also to use those funds which JTI has set aside for premises and equipment (1 500 kSEK and 3939 kSEK respectively).

Capital

JTI's own capital will be used to even out the 'natural' variations with arise due to the state of the market and to stand prepared for costs associated with institutional restructuring.

JTI's economic risk is judged to be fairly high. A worst case scenario could be that a large partner company leaves SJMF, possibly starting an exodus of other partners. In such a situation, the state base funding would probably be more difficult to obtain.

Solidity

The goal is to maintain solidity, unchanged, at a level of 32%.

Degree of consolidation

The target is to have a degree of consolidation of 76%.

					Target	Fore-cast	Target
Financial targets	2003	2004	2005	2006	2007	2007	2008
Turnover, MSEK	31,1	29,2	24,7	30,6	34	31	33
Annual resultat, MSEK	-1,2	0,6	-2,0	0,6	0,7	0,8	0,6
Profit target, %	2	2	2	2	2	2	2
Solidity, %	55	40	36	48	> 36	49	>

Owners equity and financing

Stakeholders

Base funding of approximately 10.6 MSEK is crucial for JTI's survival. This financing makes possible the continual development of JTI's expertise, which is a prerequisite for the Institute's continued activity. It is our "owners" in industry (through SJMF) and the state (through Formas) who stand for the base funding. It is therefore essential that JTI be well-regarded as a valuable, internationally competitive, resource of skills and expertise which can create value exceeding that of the contribution.

Partner companies can roughly be divided into two groups: agricultural and environmental. The agricultural sector represents a mature market where there is limited potential for partnerships with new large interests. However, new types of companies are being developed in conjunction with agriculture's restructuring, and these represent potential new partners.

The field of environmental technology is likely to offer greater development opportunities. There is still a growing market with young companies as potentially interested partners. How large this potential is and in what form it may become accessible represents another large uncertainty factor and requires further analysis.

The target for the period (2004–2008) is that the commissioned work component (assignments) from SJMF will amount to approximately 5 MSEK. During 2004 we will be revising our work methods with respect to existing and potential partners in order to establish more effective methods. Starting in 2004, each JTI employee delivering a report to an external client will complete an assessment about how satisfied the client was judged to be and which problems or other factors contributed to the client's perspective. Another alternative is to consider the possibility of using a simplified "Customer Satisfaction Index".

We have chosen to measure how much of the personnel's time is spent on projects with research grants, commissioned assignments and within the framework program i.e. projects funded internally. The aim is to reduce the time being booked against the framework program and to increase the time spent

on externally funded projects and commissioned assignments. The target for this period is that 34 % of working time will be engaged with externally funded projects. Owing to the traditional focus on obtaining research grants, we have made more progress in this area than with commissioned projects and assignments. We currently use a system for checking the quality of funding applications. Submission of applications is co-ordinated so that it can be decided which and how many submissions from JTI are appropriate for the nature and size of the available funding. Participation in multi-disciplinary projects is also strongly encouraged.

					Target	Forecast	Target
SJMF	2003	2004	2005	2006	2007	2007	2008
Stakeholders, no.	55	55	36	35	38	34	43
Commissions, TSEK	3 313	3 151	3 245	3 289	3 450	3 465	3 530

					Target	Forecast	Target
Owners equity and financing	2003	2004	2005	2006	2007	2007	2008
Other assignments and research grants, MSEK	20,3	19,8	14,6	19,8	21,1	18	21
Base funding, MSEK (Formas + SJMF)	10,8	10,7	12,2	12,2	12,2	12,2	12,2
Component of assignment coming from SJMF, MSEK	1,8	2,1	2,9	2,0	3	3,5	5
Research grants, % JTI's total working time	38	39	28	36	33	34	30
Assignment, % JTI's total working time	10	15	15	17	20	16	25
Framework program, % JTI's total working time	52	46	57	47	47	50	45

Operations

Projects

An increase in the number of large projects is interpreted as increased interest in JTI as a partner. This is also of interest from an effectiveness viewpoint. Larger projects give JTI and its employees greater long-term security while also facilitating the gathering of expertise. Smaller projects, on the other hand, fragment available experience and expertise and have a negative effect on other aspects of operations.

The perception at JTI is that the number of large projects has decreased since about 1990. There is, however, no information readily available to quantify this. For JTI a project is considered large if it extends over 18 months or longer, involves at least 3–5 people and has a budget in which JTI's part exceeds 1 MSEK.

There is presently no readily available material for viewing how the situation has developed over the last 4 years. This is because there was no previous definition of a 'large project'. It is therefore too early to formulate targets in this regard since annual variations can be significant. During this period we intend to work on establishing a basis for performing relevant evaluation.

Projects involving international contacts are important for our work on internationalisation. We are presently involved in both EU projects and other international industry-based projects. This type of project is defined as one which is funded from outside of Sweden and/or where participating researchers are from other countries.

Products

The number of products delivered is a measure of our activity and of the value we generate. We consider the following as products: equipment built for customers (e.g. protein sensors, haulm burners), patent applications, consulting assignments and reports. Articles in the daily or popular press can also be considered as a product. In order to set relevant targets for this, the changes which are to be made with the information services must be taken into account. Targets for this parameter will be formulated by next year.

Publications and conferences

With the trend toward increased internationalisation it is important to develop and maintain an internationally reputable level of skills and expertise, which can effectively disseminate our results and thereby increase our chances for collaboration with external partners. One way of evaluating if we are keeping a relevant level of expertise is to set targets regarding scientific publications, participation in conferences and symposia and, last but not least, participation in international projects.

Human resources

JTI's assets lie in the skills and expertise of its personnel. These must be nurtured and continuously developed in order to maintain an international level of competitiveness. To achieve this JTI must have a long-term competence development plan as a basis for personnel development. Potential areas of improvement, both for JTI and for staff members, are identified through the annual personnel survey and through employee development discussions. The aim is to use these tools to continuously improve both the level of competence and the quality of the working climate at the Institute.

Activity					Target	Target
	2003	2004	2005	2006	2007	2008
JTI reports, no.	12	18	19	7	12	12
Scientific publications (journals and conference proceedings), no.	34	34	24	11	36	15
International projects, % JTI's total working time	12	12			14	16
Patent applications, no.	2	6	3	5	5	4

Newly recruited staff members follow an introduction program. During 2003 this was improved after carrying out frequent follow-ups for a period following the introduction. In 2004 we will, in addition, introduce evaluations from staff members who choose to leave JTI.

Absence due to illness, particularly long absences, must be kept to a low level. Long-term certification of illness (over 4 weeks) can be used as an indication of shortcomings in the workplace. In many cases though there are causes not related to JTI. This needs to be analysed when the targets are being assessed. Our aim, in this period (2004–2008) is to reduce long-term illness to a level of 1.5%.

Personnel turnover is defined as the number of employees who leave as a percentage of the average total number of employees. Personnel turnover was significantly higher in 2003 than in previous years. In total 10 employees left JTI, of which 3 took retirement, 1 was a substitute employee, and 2 were given notice.

Human resources	2003	2004	2005	2006	Target	Target
					2007	2008
Ph.D graduates, no.	10	10	9	10	10	10
Agronomist, no.	19	14	12	13	15	13
Engineers no.	6	8	7	11	14	13
Other background, no.	20	11	10	11	10	9
Short-term illness (≤ 4 weeks), %	1,4	1,3	1,5	1,1	1	1,1
Long-term illness (> 4 weeks), %	3	0,2	0	0,7	< 1,5	< 1,5
Average age, years	43	47	48	45	< 45	< 45
Personal turnover %	22	19	16	15	12	10
Research personnel, % of total staff	80	79	79	80	80	80
Adm/info personnel, % of total staff	20	21	21	20	20	20
Turnover/Average no. of employees, MSEK	0,723	0,748	0,685	0,846	0,850	0,850

Formas, the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning, is a governmental research-funding agency. Formas encourages and supports scientifically significant research related to sustainable development.



Forskningsrådet för miljö, areella näringar och samhällsbyggande, Formas
*The Swedish Research Council for Environment, Agricultural Sciences and
Spatial Planning*

Box 1206, SE-111 82 Stockholm, Sweden. Visitors: Kungsbron 21
Phone: +46 (0)8 775 40 00, Fax: +46 (0)8 775 40 10
E-mail: info@formas.se, www.formas.se