

# Research Strategies for Environment, Agricultural Sciences and Spatial Planning

Background material to the forthcoming Governmental Research Policy  
White Paper 2004/2005



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## Foreword

During 2003, the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (Formas) has worked on developing the existing research strategy. The results form the basis for the research policy proposal, which the Council will soon submit. The strategy set out in this report lists the priorities of Formas and its needs for the next few years. It is mainly a matter of developing knowledge of the basic biological resources and their utilisation, and finding new routes to sustainable construction and societal development in towns and in the countryside. The goal is to strengthen Swedish research in the areas of science, which are the responsibility of Formas.

Formas has been in existence for less than three years, and during that time the decisions made by its precursor authorities have to a large extent determined what support the research community has received. It is only during the next financial year that Formas has the opportunity to formulate a distinct profile for its work, in both a short and long term perspective. In the previous research strategy submitted to the government and Riksdag (in November 2001), Formas described the guidelines for its field of activity and for the forms of support the Council has used in its work. It is seen from the present revision of the strategy that many of these priorities and assessments remain and, in certain respects, have been further reinforced in the course of the work. At the same time there are a number of new areas which have assumed greater significance and in respect of which the need of society for more knowledge has become increasingly evident.

Formas gives prominence to a number of thematic priorities which are of great significance for sustainable development and which can also contribute to enhancing the competitiveness of important industries. The Council also wishes to emphasise the need to develop the conditions for research on complex and multidimensional environmental problems. Formas intends to be active in initiating cooperation across disciplinary boundaries and scientific areas. It is also essential that the forms of research support should be instrumental in strengthening Swedish research. Proposals regarding the way in which the different forms of support can help reach these goals are also set out in the background material. The strategy that is now presented is part of continuing work on defining the role of Formas in both the national and international perspectives.

As one of the new national research funding organisations, Formas has taken part in producing a joint report, which deals with the conditions governing Swedish research and with the finance that is required to maintain the position of Sweden as a leading research nation.

LISA SENNERBY FORSSE  
Secretary General



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## Summary

Formas shall promote outstanding research for sustainable development. The research supported shall meet high demands for scientific quality and, where this is applicable, be relevant for the sectors of society concerned. By calling for applications for funds that are not tied to programmes, Formas satisfies the need for diversity and provides the opportunity to test new ideas in research. The Council shall also provide an impetus in initiating research that promotes economic growth in the sectors affected. It is intended that the investment that has begun in multidisciplinary research shall continue and expand. Formas shall further promote internationalisation of Swedish research and shall communicate the research results arrived at in such a way that these can prove beneficial to the development of society.

In order to create synergistic effects in the form of high quality research and to increase financial resources for research, Formas cooperates with other players in the research system both nationally and internationally. During its first three years of activity, Formas carried out a number of jointly managed and jointly executed projects with other research funding agencies. These activities have resulted in a proposal for national research programmes and/or more effective collaboration in financing existing and new research areas. Formas supports and participates in the research cooperation in the greater Europe and within the Nordic countries, and intends to take an active part in following up the UN Conference in Johannesburg.

Among important environmental issues, Formas gives special prominence to research on climate, environmental toxicology and biodiversity as prioritised areas. Environmental social science research, including human attitudes and behaviours, is another important area of cooperation with the other affected research funding agencies. In research of a more sectorial nature, Formas intends to focus on multifunctionality in agriculture, continued research on sustainable and economically profitable management systems on land and water, food research, and the new biology with its potential and risks. The areas, which are accorded priority in spatial planning, are mainly research on the integration of environmental and energy issues in the construction of the built environment, research into materials, adaptation of society and the construction sector to climate changes, risk management issues and sustainable urban and rural development.

Formas regards it as very important that research results should be communicated to the players in society in order that they should be applied and provide benefits. In this respect, contacts between the sectorial institutes and the industries concerned have an important part

in transferring and implementing research results. Formas also continues its endeavours to create a platform for dialogue between research and practice.

In order that favourable conditions may be created for the development of Swedish research and for Sweden to retain its role as a prominent research nation, it is essential that the forms of research support should help achieve these goals. Formas endeavours to bring about a well-balanced distribution of research resources, with the emphasis on researcher influence where the approval rate should be increased, investments in special programmes within prioritised multidisciplinary areas, strategic investments in strong research environments, and support for young researchers and postdoctoral research centres.

In order to satisfy the needs for adequate funding of best research as support for sustainable development and economic growth, Formas has identified a need for financial augmentation totalling MSEK 400 annually. In our opinion, this is essential in order that Sweden should live up to its reputation as a prominent knowledge nation.

### **This augmentation comprises**

- An increase in the support that is directly distributed to individual research projects by MSEK 200 annually.
- An increase by MSEK 40 annually to enable a concentrated investment to be made in strong and internationally competitive research environments.
- A special input by MSEK 50 annually to build up investments in multidisciplinary programmes.
- An increase by MSEK 20 annually for urgent research into the effect of climate change on sustainable development, within the framework of a national research programme.
- An increase by MSEK 40 annually for fundamental research in the field of environmental toxicology, within the framework of a national research programme.
- An increase by MSEK 50 annually for research on customised foods and the quality and safety of the raw materials, within the framework of a national research programme.

## The role and responsibility of Formas

In accordance with the government's instructions, the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (Formas) shall support research at universities and research institutes that satisfy stringent demands for high scientific quality. Research shall also, where this is appropriate, be relevant for the sectors of society concerned. The Council shall be responsible for fundamental research at the initiative of researchers and for strategic programmes with the principal emphasis on sectorial and/or societal relevance. Formas shall take the initiative for special investments in urgent areas, with special attention to multidisciplinary and interdisciplinary research efforts. The Council shall further endeavour to ensure that cooperation is established with other research funding agencies and with the business sector.

The responsibility of Formas to promote research for sustainable development implies that the Council shall provide an impetus for development in the fields of the environment, agricultural sciences and spatial planning. Formas shall initiate research in order to enhance knowledge regarding aspects that favour a sustainable societal development, and shall at the same time contribute to economic growth. In the ultimate, it is a matter of developing more knowledge about the state and function of ecosystems, and about the conditions required for the changes in society, which will be needed over the next thirty years. The research supported by Formas shall be instrumental in achieving the sectorial development targets, shall bring about cooperation and collaboration between researchers and the users of research results, and shall promote international cooperation within the areas in which Formas is active. Pressure on global systems is steadily increasing, and Formas must contribute to the global body of knowledge by supporting outstanding international research in order to develop new and urgent knowledge in these areas.

In order that reliable research results may be produced which can form the basis for decision making, there is a need for both fundamental and need related research of high quality in the areas for which Formas is responsible. The Council also has great responsibility to satisfy the need for diversity and to make it possible for new ideas to be tested in research. By the merger of former research funding authorities, Formas has been given a central role in the work of providing Swedish research with the best possible conditions for its contribution to sustainable development in both a national and an international and global perspective.

### Formas shall:

- promote research of high quality
- take the initiative for research on sustainable societal development
- promote research of significance and benefit for the affected sectors
- promote new approaches and innovative ideas in research
- promote internationalisation of Swedish research
- communicate the research results arrived at so that these can influence the development of society

## National and international cooperation

The national organisation for research funding shall be an effective tool in promoting the research policy goals, strengthening the Swedish system for research and development, and intensifying the contribution which research makes to the international competitiveness of Sweden and a sustainable development of society. In order to create synergistic effects and research of high quality, and to increase financial resources for research, Formas cooperates with other players in the research system both nationally and internationally. During its first three years of activity, Formas carried out a number of jointly managed and jointly executed projects with other research funding agencies. These activities have resulted in a proposal for national research programmes and/or more effective collaboration in financing existing and new research areas.

### National cooperation

The recent reorganisation of the research funding system in Sweden – which resulted in the establishment of Formas – has worked satisfactorily as far as Formas is concerned. Formas collaborates mainly with the Swedish Research Council, the Swedish Council for Working Life and Social Research (FAS) and the Swedish Agency for Innovation Systems (VINNOVA), but also with the Swedish Foundation for Strategic Environmental Research (MISTRA), the Swedish Foundation for Strategic Research (SFS), the National Environmental Protection Agency, the Swedish Energy Agency, Sida/Sarec and others. Formas has taken a special initiative to establish coordination with the affected research funding agencies in matters concerning research in the fields of climate, environmental toxicology, food, forestry and environmental social science research. Formas also closely cooperates in research issues with the sectors of society and industries, which border on its field of activity. These are the construction sector and the agricultural industries. Together with the Construction Sector Innovation Centre (BIC), Formas will develop the declaration of intent concerning cooperation, which was entered into in 2003 and has so far resulted in a joint call for research applications. Formas shall in addition, in cooperation with BIC, submit to the government by 31 December 2003 a research strategy for sustainable societal development.

Under the spending budget of the Ministry of Agriculture, about MSEK 50 annually is allocated for research co-funded with the business sector. In the fields of forestry, agricultural engineering and plant improvement, work is regulated through special agreements with the sectors concerned in which the parties undertake to finance this by 50 percent each. Within forestry and agricultural engineering research, the agreements imply that the parties jointly

### Formas shall

- endeavour to bring about increased co-funding of research
- develop the current co-funding agreements
- closely monitor developments within both the institutional sector and the university system in order to adapt its work to new needs

undertake to finance a certain proportion of the basic work at the research institutes Forestry Research Institute of Sweden (SkogForsk) and Swedish Institute of Agricultural and Environmental Engineering (JTI). In the field of horticultural research, discussions are at present in progress with the representatives of the sector concerning joint funding of a research programme extending over a number of years. Similar discussions on joint funding of a three-year research programme concerning food are held with VINNOVA, the Swedish Farmers' Foundation for Agricultural Research (SLF) and with the food industry through the Swedish Association of Convenience Foods Traders (SDH), the Swedish Food Federation (Li) and the Federation of Consumer Non-Durables Suppliers (DLF).

In the government bill R&d and cooperation in the innovation system (Bill No 2001/02:2), IRECO is commissioned to bring about further restructuring of the industrial research institutes where the State, as owner, is represented by IRECO. Work has gone on for some time, and the results of this investigation and those of internal reviews in progress within the institutes may influence the further work of JTI and SkogForsk. In the view of Formas, it is important that finance for work at these institutes should continue. Formas is also following with interest developments within the concept United Competence where several institutes collaborate. Institutes within the sphere of activity of Formas have an important role both in identifying sectorial research needs and performing research, and in transmitting the results of research to the sectors concerned and society at large. Cooperation by the institutes with the industries, which is often well developed, is instrumental in ensuring that the period between the publication of research results and their implementation is shortened and that the results can thus be utilised in a reasonable time.

Cooperation with the Swedish Road Administration and Swedish Rail Administration may intensify since these authorities finance research in areas, which border on those of Formas. Formas is also closely cooperating with the academies of sciences, Royal Academy of Sciences (KVA), Royal Academy of Agriculture and Forestry (KSLA) and Swedish Academy of Engineering Sciences (IVA). Work on a Food Foresight has started at KSLA, and there are plans for a Construction Sector Foresight.

The Swedish university system is at present undergoing a rapid process of change – this applies in particular to the technical universities. According to the universities, economic problems due to inadequate grants for faculties are threatening the quality of research. Owing to a rapid adaptation to the changed needs of industry and other changes in society, there is a need for organisational changes and different priorities with regard to subject areas and research directions. Increased investment in the formation of research centres to cope with the need for interdisciplinary and multidisciplinary research will eventually demand new forms of funding.

**Formas shall**

- promote internationalisation of research
- prioritise research cooperation within the greater Europe
- continue the Nordic research cooperation
- follow up the UN Conference in Johannesburg

**International cooperation**

Sweden functions in an increasingly globalised world where more knowledge is needed on how democracy, welfare and human rights shall be secured both inside and outside Sweden. The global environmental threats, for instance climate change, demand large scale international efforts and a highly developed research cooperation among countries. Sweden should contribute to the global body of knowledge through internationally outstanding research in order that new and urgently needed knowledge should be developed in these important areas. Sweden should also, in important areas, be a resource-rich partner in the research cooperation with countries in the southern hemisphere.

Research is by its nature international, and the aim of the work of Formas is to promote international contacts, to bring to Sweden new knowledge, new ideas and experiences, and to contribute to increased Swedish participation in international research cooperation. For quality assurance of Swedish research, it is essential that internationalisation should be a natural element in the project funds granted by Formas. Formas also provides support for Swedish participation in, and arrangements for, international conferences for researchers. International experts regularly perform evaluations of different areas of research within the ambit of Formas.

**Europe**

Sweden is a member of EU and takes an active part in European research cooperation. Within Formas, European research cooperation is a prioritised activity. It is a matter of both the mandates given by the government and Riksdag to support Swedish participation in different EU bodies, and active promotion of participation by Swedish researchers in the framework programme for research. At present, Swedish is having an input within the 6th framework programme in Food Safety (priority No 5) and Global Change and Ecosystems (priority No 6.3). Formas took an active part in the preparation of the 6th framework programme, and expects to participate actively to the same extent in the development of the 7th framework programme.

It is considered that the participation of Formas within the framework of European Research Area – ERA net – will increase over the next few years. One example is cooperation in marine environmental research with the Baltic countries, another cooperation within the forestry sector to promote wood as a raw material in industry. Formas is continuing this cooperation with the focus on both the research policy consultation that is taking place there, and the cooperative platforms within different areas of research and international conference activity.

**The Nordic countries**

Nordic cooperation is important for several sectors within the sphere of responsibility of Formas. Formas intends to continue cooperation within the cooperative agreements that are in existence or being developed under the auspices of the Nordic Council. The reason for

continued Nordic cooperation in the areas covered by Formas is that we have the same physical geographical conditions in the Nordic countries. There is also a close relationship and linguistic and/or cultural similarities within the Nordic area, which can provide considerable networking gains. Development of Nordic Centres of Excellence may prove competitive within a pan-European framework.

Cooperation may be both multilateral (all the Nordic countries inclusive the Baltic area which is assuming increasing importance) and bilateral (as in the case of the Swedish-Finnish forestry collaboration). Bilateral arrangements can utilise special conditions, and may also be strong instruments in developing a more multilateral Nordic or European cooperation within some special field. This is the case for the forestry sector where several of the companies are active in different countries.

### **Other countries of special interest**

Formas is participating in the Swedish cooperation to promote Swedish-Japanese contacts regarding sustainable development. The reason is that Japan is an important highly industrialised country with a lot of research in areas that are close to those covered by Formas. Ongoing bilateral cooperation with France within agricultural and forestry research is judged to be working well and it is intended that it should continue. Formas is also participating in a trilateral cooperation with USA (NSF), Norway (Norwegian Research Council) and other Swedish interested parties, e.g. the Swedish Research Council, in areas such as climate, biodiversity and polar research. Other countries that are of interest for future cooperation at council level are e.g. Canada, China and Australia.

### **Cooperation with the southern hemisphere**

Formas is at present participating with the Swedish International Development Authority SIDA in a project to promote research cooperation between Sweden and South Africa, as well as Asia and North Africa (Asian Link). Follow-up of the UN Conference in Johannesburg on sustainable development demands inputs in a north-south perspective. Another research platform with the focus on the southern hemisphere is the work, financed by Sida/Sarec, in the global Consultative Group on International Agricultural Research (CGIAR). Work at the 16 research institutes – located in the developing countries – concentrates mainly on agriculture, forestry and fisheries. It is important that the action areas specified at the UN Conference in Johannesburg in 2002 should be developed further over the next years.

### **International organisations**

During 2003, Formas carried out an evaluation of Swedish participation in the International Institute for Applied Systems Analysis (IIASA) near Vienna, which has around 15 member countries. The evaluation finds that there is limited interest in IIASA within the Swedish researcher community, but in spite of this it recommends participation for a further period.



Global environmental issues are occupying an increasing proportion of the work of the institute, which should be of benefit and interest for Swedish research. Formas intends during the period to ensure that the Swedish researcher community has greater knowledge of IIASA, and to participate in the ongoing development work at the institute.

Formas is taking part in the internationalisation of energy issues in the built environment by representing Sweden at the International Energy Agency (IEA). Formas intends to continue its participation in this cooperative body for research. The same applies to the International Council for Research and Innovation in Building and Construction (CIB), the international cooperative organisation for building research. During 2003-2004, Formas and the Swedish Research Council hold the chairmanship and secretariat for the International Group of Funding Agencies for Global Change Research (IGFA).

## Needs and priorities within the research areas of Formas

### Overarching environment related research

Many important environmental issues are specifically sector related, while others have a greater generality. Under this heading, only four more general subjects will be briefly dealt with, namely environmental social science research, climate, environmental toxicology and biodiversity. The first three are research areas where Formas has a coordinatory responsibility, while in relation to climate and environmental toxicology a report has already been submitted to the Ministry of the Environment in the form of a proposal for national research programmes.

### Environmental social science research

The environmental issues of today and the future are often complex, and have so far mostly been studied from a natural sciences perspective. It is however essential that the social sciences and the humanities should also take part in research in order to elucidate the relationships between the function and status of ecosystems and a sustainable societal development. The concept of sustainability comprises three dimensions – ecological, economic and socio-cultural. To get these three dimensions to function together requires a system approach and multi-disciplinary research inputs. Formas has been given the task of coordinating the environmental social science research, and work on this has recently started. The aim is to chart ongoing research, identify gaps in knowledge and the need for more knowledge, and to initiate co-operation to enable directed efforts to take place within urgent fields of research.

### Climate

According to the assessment of the Intergovernmental Panel on Climate Change (IPCC), concentration of greenhouse gases in the atmosphere continues to increase, and the mean temperature of the earth will rise by 1.4 – 5.8 degrees in 100 years. Such a temperature rise can have sweeping consequences for society, even in Sweden. Countering this anthropogenically induced greenhouse effect and its negative impacts is a global challenge. A proposal for a national climatic research programme has been drawn up by Formas in collaboration with other affected organisations, and has been submitted to the government.

The programme states that climate research needs increased support. In addition, special funds should be allocated directly from the national budget to the Rossby Centre for climatic modelling. The programme sets out research needs and gaps in knowledge, and defines the spheres of responsibility of the different funding agencies. The vision is a coherent Swedish input in climatic research comprising both new and ongoing activities in fundamental research, climatic modelling and research motivated by climatic policy.



### Formas focuses research on

- greenhouse gas balances for different ecosystems
- the effects of climate change on different ecosystems
- effects on, and risks for, the infrastructure and buildings and a need for adaptation

#### Formas focuses research on

- low-dose and synergistic effects
- dispersion, concentration and transformation of noxious chemicals in the environment
- risk and hazard assessments

As far as Formas is concerned, it is proposed that its responsibility should be to finance fundamental need related research concerning

- i) greenhouse balances for different ecosystems,
- ii) the effects on ecosystems, and
- iii) the effects on societal infrastructure and the need for adaptation.

For the first two items, the gaps in knowledge have been defined in a dialogue with the research community for forest land, arable land, bogs, hilly regions, lakes and the Baltic. For the third item, gaps in knowledge have been identified under the headings the safety of dams, geotechnics, the stability of slopes, pollution and hydrology.

Climate research must also be related to a number of other areas, terrestrial and aquatic environments and the engines of global climate change. The coupling of this to different possible strategies for dealing with these issues nationally and internationally should also be considered in a risk perspective.

#### Environmental toxicology

Dispersion and concentration of noxious chemicals in the environment is a serious threat to sustainable societal development. Humans and animals are constantly exposed to a large number of chemical compounds, many of which have not yet been subjected to risk assessment regarding their negative effects on health and the environment. Compounds that are difficult to decompose and which accumulate in the food chains pose a special problem. Fundamental environmental chemistry and environmental toxicology research is of key importance if Sweden is to be able, in the international arena, to pursue forcefully issues to do with chemicals. The chemicals strategy of the EU underlines the need for both national and joint EU research in this area.

While the demand for knowledge increases, state funding has decreased by ca MSEK 40 over the past 15 year period, from a level of ca MSEK 100 annually in 1990. The report Environmental toxicology research programme (2002) which resulted from the coordinatory mandate of Formas in this field points out that a substantial rise in research finance is required here, at least to the same level as in 1990. According to the proposal, this increase should in the first place be given for fundamental research.

One of the arguments put forward for new research inputs is that the complexity in exposure and low-dose effects has made the risk panorama increasingly difficult to overview and to assess. The health and environmental effects of persistent chemicals, and the synergistic effects between chemicals, are important areas. There are significant risk assessment problems concerning the effects on the hormonal system, the development of the nervous system and

the function of the immune system in animals and humans. The dispersion and transformation in air, water and organisms of intentionally and unintentionally formed environmental pollutants are also important areas for research. Knowledge of the exposure of animals and humans is of central importance for toxicological work, especially for the development of methods for risk and hazard assessment and for research concerning the relationship between dose and response.

The report proposes a number of urgent inputs, which are to be jointly financed by Formas and other funding agencies, in addition to the extra investment in fundamental research referred to above. One proposal relates to the establishment of an interdisciplinary postdoctoral research centre with the aim to strengthen the build-up of expertise in this field.

### **Biodiversity**

Sweden has ratified the Rio Convention on biodiversity and has therefore undertaken to preserve biodiversity in Sweden. Biodiversity is also listed in the proposal as the 16th national environmental goal. The term biodiversity relates to variation at the level of genes, species and ecosystems. The Swedish landscape has for a long time been impoverished of biodiversity, and the existence of a large number of species is threatened to varying degrees. It is therefore essential to preserve and restore biodiversity. This demands knowledge and research.

The Riksdag has allocated extra funds for research on biodiversity and for support for ecologically sustainable development. Over the period 2000-2004, a total of MSEK 400 has been allocated to Formas and the Swedish Research Council. A further MSEK 40 was allocated to the Species Databank at the Swedish University of Agricultural Sciences (SLU). Most of the funds received by Formas were distributed after a call for applications at the end of 2000.

This call has four themes:

- The status and development of biodiversity
- Factors that affect biodiversity
- Measures for the preservation or restoration of biodiversity and its functions
- The significance and utilisation of biodiversity in sustainable societal development

Funds were distributed reasonably equally among the above themes. Apart from individual projects comprising a large number of postgraduate students and research assistants, three postdoctoral research centres and a number of national groups that are significant for research on biodiversity are also financed. If these special funds are granted regularly, Formas intends to continue support for a long-term build-up of knowledge to promote work on securing biodiversity. In this context it is essential to pay attention to an international perspective on these issues, so that these aspects also can be catered for.

### **Formas focuses research on**

- the status and development of biodiversity
- factors that affect biodiversity
- preservation and restoration measures
- the significance and utilisation of biodiversity in sustainable development

### Formas focuses research on

- the multifunctionality of agriculture
- reduction of non-renewable agro-chemical inputs
- leaching and recycling of nutrients
- preservation and recreation of biodiversity
- new or modified cultivation materials
- the potential and risks of genetic engineering



## The land based industries

In this context, the term land based industries refers to the industries, which use land or water for the production or catching of biologically related goods and services. Today, the land based industries exhibit a greater variety of goods and services than had been the case before. This greater diversity must be taken into consideration as regards the needs for research.

### Agriculture and horticulture

Agriculture is today regarded not only as a producer of food; it also supplies important services in the form of e.g. a visually attractive landscape with open fields and pastures. The large number of horses that are used for recreational purposes are a common sight on pastures. Today there are almost as many horses as cows. Holidays on farms have increased in popularity. Growing of energy crops occurs to some extent in certain regions, and there is potential for growing other industrial raw materials. A specialised and small scale horticultural production may assume greater significance as one of several sources of income on the land. In order that rural areas may survive, there is need for research that contributes knowledge of how the multifunctionality of the agricultural landscape can be developed.

In the same way as forestry, agriculture and horticulture have the advantage that they produce renewable products. There are however certain central sustainability problems where research is urgently needed. There is extensive use of agrochemicals, which are in most cases non-renewable, and of fuel and certain commercial fertilisers. Research should promote changes so that the use of agrochemicals can be reduced or replaced by renewable products. There is extensive use of chemical pesticides, and there is some leakage to groundwater and surface water. Research should aim to develop alternatives to chemical pesticides, and this necessitates, inter alia, fundamental research into the defensive systems of plants and their interaction with pests. Research on organic production should be coordinated with that on conventional forms of crop production, since the principal objective is that all agricultural production should be sustainable.

Nutrients are leached from arable land and account for a significant proportion of the eutrophication of the aquatic environment. Research that investigates the possibilities of retaining a greater proportion of plant nutrients in the cropping system is urgently needed. The nutrients that remain in products for sale are recycled to only a limited extent. The conditions for increasing this recycling, and its appropriateness, should be investigated. Over time, the agricultural landscape has been greatly impoverished of biodiversity, as a result, inter alia, of the use of pesticides, destruction of small biotopes and extensive reduction in the size of meadows and pastures. Preservation and recreation of biodiversity in the agricultural landscape is an important research area. For a multifunctional agriculture it is necessary that there should be effective interaction between mutually dissimilar forms of production. Examples

of this are different combinations of agriculture and horticulture. Fragmentary research in this area must be coordinated and intensified.

Genetic engineering opens up the possibility of developing resistant and high-yielding crops. Swedish biotechnological research is at present among the best in the world, but there is a risk that it will fall behind unless research grants are increased. This applies to both fundamental research and innovative application of the results. Within the life sciences there is a high degree of cooperation and internationalisation at present, and for the past ten years or so research has focused on a number of model organisms. New methods such as functional genomics, proteomics and metabolomics have given researchers new tools for large scale experiments which both generate enormous quantities of biological data and demand expensive investments in apparatus and computing power. In order that Sweden should be able to hold its own in the international competition, these expensive but highly effective methods are a must. Institutional funding, which is at present the system in Sweden will however cease in a few years. This means that the agencies, which fund modern biological research, should assume a joint responsibility. The increasing tendency for researchers to collect around the tools will probably mean that in the long run work will be concentrated at a smaller number of major research centres. Formas is financing a number of multidisciplinary projects, which deal with the risks and risk predictions associated with growing GM crops. In the opinion of the Council, research on risk and risk management should keep pace with developments in biotechnology.

### **Veterinary medicine and animal sciences**

The responsibility of Formas comprises both the productive animals of agriculture and non-domesticated animals, pets and research animals. The research aims at healthy and thriving animals and animal husbandry that is carried out in a way that is both ethical and defensible and does no harm to either the environment or human health. Research on the production animals in agriculture shall in addition contribute to making the activity economically profitable. The significance of pets for human wellbeing is an important field of research, which needs a multidisciplinary input.

Sweden is at the forefront as regards animal welfare issues. There is need for research that seeks to define objectively what is meant by animal welfare and endeavours to develop knowledge of how this can be best promoted in animal husbandry. The provision of feeding stuffs has a central role, and research is needed to optimise the quality of fodder to accord with the needs of different animal species. Knowledge of the nutritional physiology and metabolism of different species must be intensified. Issues to do with infectious disease control and food safety are another area where research is urgently needed in order to prevent the risks of disease in both animals and humans.

### **Formas focuses research on**

- animal welfare
- infectious disease control and food safety
- relationship between nutritional physiology and fodder quality
- breeding strategies and reproduction, including the potential and risks of genetic engineering

The properties of animals and thus the quality of foods of animal origin are to some extent genetically conditioned. Management of biodiversity among domesticated animals and adaptation of the properties of animals to the demand by meat consumers, farmers and the owners of pets requires a properly thought-out improvement strategy which, in its implementation, can be based on both traditional breeding techniques and genetic engineering. The part of the new biology that is to do with the spheres of responsibility of Formas comprises, inter alia, reproduction research. Here, fundamental research is essential to retain a broad basis for future applications that are not known about today. One branch of this research consists of cloning research, which is not pursued in Sweden at all at present. There is a clear need for a rapid build-up of such research on a national basis so that the fundamental mechanisms regarding cloning may be elucidated. The principal aim is not to produce cloned individuals, but Swedish research is necessary, mainly because it is an important element in the work on enhancing the knowledge and understanding of fundamental biological processes. Possible future applications include therapeutic cloning for medical purposes. Owing to the growing need for risk assessment and ethical discussion regarding genetic modification as a whole, and also cloning, safety research which is at present a long way behind the biological advances should receive more attention. This will be particularly important when the aim of research is to develop knowledge regarding possible applications. Risk research and societal aspects are in this connection of great importance so that practical utilisation of the new techniques may be firmly rooted among different players.

### **Foods**

The food industry is an important industry in Sweden. For humans, food is both a basic necessity and a source of pleasure and problems. In the rich world, the basic needs have for a long time been satisfied. Meals occupy a central role in social life, and there is great interest in food and cooking. At the same time there are problems of excess such as obesity and food related coronary diseases. Food is an agent of dispersion for many diseases, and food safety is therefore a subject of great importance.

Food research is multifaceted and constitutes only one part of agricultural and fishing research. It comprises research into production, processing, distribution and consumption of food and is represented in many areas of science. Research concerning the environmental aspects of food production is mainly dealt with under the section on agriculture and horticulture above and fishing and aquaculture below. Research on fish as food is only of limited scope at present, and therefore it probably has great development potential.

At present, the responsibility that Formas has for food research relates mainly to the raw materials for food. Research into the ways in which plant breeding and animal husbandry are to produce raw materials of high quality is important. Food safety in the sense of the concentra-

### **Formas focuses research on**

- the relationship between plant breeding/animal husbandry and raw material quality
- food safety
- the relationship between the properties of raw materials and the flavour, nutritional value and health effects of foods

tion of different toxic substances (heavy metals, medication residues and pesticides, fungicides) in raw materials is prioritised, as well as research that elucidates the relationship between the properties of raw materials and the flavour, nutritional value and health effects of foods. The relationship between food and health is receiving increasing attention and demands interdisciplinary research with the emphasis on medical aspects.

Formas has a mandate to draw up, in collaboration with other funding agencies and affected authorities, a proposal for a national programme for food research. The report will be submitted to the government on 1 December 2003.

### **Fishing and aquaculture, aquatic ecosystems**

Fishing is an important industry along Swedish coasts. To this must be added a large interest in recreational fishing and new investments in aquaculture. Over-fishing of important species is an issue of great significance and measures to protect fish stocks are essential, but they are at times controversial. The debate on prohibition of fishing for cod demonstrates the importance of research concerning the management of fish stocks. Fundamental knowledge should be developed regarding sustainable use of natural resources in lakes and seas. In order that an environmentally friendly, animal ethically defensible and economically profitable aquaculture may be developed, new knowledge is needed.

In ecology, priority is given to research on the dynamics and structure of fishes and crustaceans at the individual and community levels, of both wild and cultivated origin and at a multi-species level. The objective is to contribute to sustainable management strategies, which give consideration to e.g. the availability of resources and biodiversity. Behavioural ecological research is needed, inter alia for the development of cultivation methods in aquaculture, and genetic engineering provides scope for customised cultivation materials for different applications. There is an urgent need for studies of the risks involved in aquaculture and the release of farmed/modified fishes. Research on fish diseases inclusive of epidemiology and immunology is important. Social science research is needed for an understanding of the economic and social significance of fishing and to find possible developments.

The aquatic ecosystems are exposed to strong anthropogenic impacts which give rise to changes in water quality and biodiversity. Apart from fishing and aquaculture, they are affected by e.g. land use and discharges to waters in the catchment areas, the deposition of airborne pollutants, shipping and construction in and near water. A future warmer climate may also affect ecosystems. Research should throw a light on the extent and mechanisms of anthropogenic impacts, and also lay the scientific foundations for various measures, which reduce or exclude unfavourable effects.

### **Formas focuses research on**

- the dynamics and structure of fish stocks
- management strategies of long term sustainability
- the potential and risks of aquaculture and genetically modified cultivation material
- diseases of fish
- the significance and development potential of fishing
- anthropogenic impact – mechanisms, countermeasures

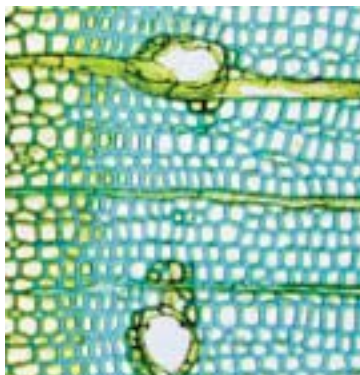


**Formas focuses research on**

- the ecological, economic and social/cultural aspects of reindeer husbandry

**Formas focuses research on**

- new/changed cultivation materials and forestry methods for increased production, better adaptation to customer demands and economy
- the potential and risks of genetic engineering
- different threats – consequences and risk management
- biodiversity – preservation methods and strategies

**Reindeer husbandry**

Even though reindeer husbandry is of relatively little economic importance on a national level, it has a not insignificant economic and social importance on a regional level. For the Sami population, reindeer husbandry is of great importance. Reindeer husbandry preserves natural grazing grounds and transforms them into economic, social and cultural assets. An increasingly prominent dimension of reindeer husbandry is that it creates employment and is a factor that provides cohesion in the Sami community, and is a historical basis for Sami culture and identity.

Research into reindeer husbandry should have a broad based approach towards the development of knowledge and management alternatives, which make reindeer husbandry sustainable in an ecological, economic and social perspective.

**Forests and forestry**

Forests and forestry are of great importance to the Swedish economy, for the wellbeing of the Swedish population, biodiversity and the carbon balance of the country. Forestry yields a product, renewable timber that is attractive from the standpoint of sustainability. Today, Swedish forestry has two well formulated goals for its work – the production goal and the environmental goal. The significance of the forest as a carbon sink is in addition a part of climatic policy. There is also another goal that is not often mentioned, that of preserving the cultural heritage assets of the forest. Probable future goals relate to the significance of the forest for recreation and human wellbeing, especially in areas near towns. All in all, this poses entirely new challenges for research about the forest, and it should therefore be even more forward looking and multi-facetted than today.

These existing or possible future goals compete with each other for land and resources, and individually and together they demand new knowledge and thus research. The production goal requires research on how the effectiveness and profitability of the Swedish forestry sector can be increased. New forestry techniques, new/changed cultivation materials and new methods for increased forestry production, better customisation of wood and fibre properties and new fields of application are some of the possible routes to improved economy. The nutritional balance of the forest is a central sustainability aspect that demands constant attention. The forest is exposed to different pests that may at times cause far-ranging impacts, and to external threats such as storms, the greenhouse effect and pollution. Development of methods and tools for better analysis of risks and impacts, and possible preventive measures, is therefore an important field of research. Providing finance for research into acute problems such as the Gremmeniella attack on pine in recent years poses difficulties at present. Formas has no means to allocate sufficient funds at short notice for such unplanned inputs, and the responsible authority, the Swedish Board of Forestry, has no research funds of its own at present. The forest can further be instrumental in slowing down the greenhouse effect, both temporarily

as a carbon sink and in the long term by producing biofuel. This is an important research area, which is at present financed by the Swedish Energy Agency.

The environmental goal is at present primarily directed towards the preservation of biodiversity. Many nature conservancy measures that are taken today have no solid scientific basis. Continued research on biodiversity in the forest is urgently needed to lay the foundations for conservation strategies and to investigate the effect and economy of nature conservancy measures. There is a continuing need for knowledge on how the impact of forestry on leaching and water quality can be reduced. It is likely that the social values of the forest will be accorded greater importance in the future. The forest as the source of recreation and wellbeing provides scope for much potentially important research. One important field of research is the way in which the different demands on the forest which are listed above can be reconciled and optimised in time and space into a successful multi-faceted economy where both the need of forestry for economic growth and the needs of society as a whole are taken into consideration.

It has been pointed out before in several contexts that it is unfortunate that research concerning the value chain production – consumption is not financed in a cohesive manner. Today, Formas finances the raw material related part of the value chain and VINNOVA processing and product development. Formas finds that the cooperation with VINNOVA is working well; cooperation in the programme Wood Material Science is an expression of this. In the judgment of Formas, this divided funding of the value chain can work even in the future in view of the coordinatory responsibility given to Formas and the planned development of a national research programme. Should Formas be given greater responsibility to include even forestry industrial processing, this will naturally require greater resources for Formas.

### **Sustainable spatial planning**

The construction sector is an important part of the national economy and has a great influence on employment, public health, environmental development and the use of natural resources. The construction sector deals with the technical infrastructure in the form of buildings, installations for water and sewerage, energy supply, transport and communications. Buildings inclusive of the external environment in the form of gardens, parks, churchyards etc represent great cultural assets. Preservation and renewal of this cultural diversity poses extensive demands for research. Rapid developments in the form of new materials, deregulation and changes in regulations, changed forms of funding and the increased demands for greater consideration for the environment also give rise to new research needs. These issues can also be broadened so as to embrace the considerably greater issue of who has the power over spatial planning. Municipal development issues are now dealt with in more informal and less regulated forms. Collaboration between public and private investment capital is often required in order that projects may be carried out, and this raises questions on how control, public participation and planning democracy can be satisfied. Tools must

### Formas focuses research on

- integration of environmental issues into the construction process
- the way people perceive and view the indoor environment
- the causes of building related health effects
- synergistic effects between energy and building development issues



be developed that can channel and control requirements raised by a large number of interested parties with conflicting interests. This is something that may, in turn, demand new expertise and perhaps also new organisational forms. Research inputs of a multidisciplinary nature are needed in this respect. This applies in particular to the development issues associated with the relationship between town and country.

### Environmental and health issues

One of the great challenges faced by the construction sector is integration of environmental issues into the construction process. The "Bygg-Bo" dialogue of the government is one of several examples of activities in the construction sector that require a stronger coupling with research. Through the Environmental Code, the demands for greater consideration of the environment in construction have been focused on the individual player who has the responsibility to demonstrate that the necessary environmental considerations have been taken. The environmental issue also has great significance for the competitiveness and good standing of the companies. Environmental issues are therefore not only a matter for the lawyers of the companies but also have great significance for the development of the companies' quoted share value. The way environmental work is to be carried out, where in the organisations the possibilities and obstacles reside, are a difficult problem for companies that demands research. Can environmental issues compete with profitability and market shares in a company? Are environmental issues merely one way of increasing market shares, or is there a change in the way companies and organisations regard nature and its sustainability?

A sustainable built environment that can meet new threats to the environment and health needs research that is both multidisciplinary and of high quality. More knowledge is needed about sensitive groups, environmental effects and interaction effects. There is a need for continued research inputs that increase knowledge of how people perceive and view the indoor environment in relation to their needs, and the factors, which influence this view. It is also essential that the causes of different health effects, which, may be building, related should be more clearly elucidated. What is needed most of all in this respect is to develop reliable methodology for the identification of the sources of problems in the indoor environment. Financial cooperation should be established with FAS, the Swedish Research Council and the Foundation for Research into Health Care and Allergy.

Sustainable development of society also demands that methods and a regulatory framework should be developed for collaboration in energy planning and building planning. The report from the recently completed Energy Foresight in Sweden, in which Formas participated, demonstrates the continued strategic role of building development for necessary energy management and effectivisation. This may take the form of eco-cyclic local energy systems in which a building integrated energy production, with alternative forms of energy, can

function as a complement to existing systems. Photovoltaic cells can provide interesting solutions in future. New systems need to be developed for the production of electricity and heating/cooling in the buildings themselves. The building services systems must be developed and analysed with respect to economy, environment and energy effectiveness. In the light of this, it is important that Formas should continue to be responsible for research on the energy effectiveness and energy use of buildings. In the field of energy research there is also scope for creating synergistic effects with other research areas financed by Formas, for instance with regard to land use and the nutritional balance of land within the agricultural sectors.

### **Materials science**

Formas is at present working with a number of other research funding agencies – mainly the Swedish Research Council and the Swedish Foundation for Strategic Research – in the field of materials sciences, a dynamic and important field of research where international developments proceed at a fast pace. In several areas, Swedish materials research is of high international standing.

Smart materials, e.g. ceramic materials that can repair themselves, can set themselves in motion and can convert thermal energy into mechanical work, are an interesting area. Other fields of research with a materials coupling are Biomimetics, which deals with mimicking nature. Fundamental research on the function of different biological organisms and the way nature has solved problems concerning bonding, maintenance of heat etc may in the long term be very important. From the standpoint of Formas, nanotechnology research is also important, especially in view of its application potential in the construction sector. It is a matter of creating strong materials of low weight and good performance, materials with intrinsic intelligence (IT) etc.

Formas considers that Sweden, in the same way as other industrialised countries, should continue investing in research into more traditional kinds of materials and materials technologies. The investment of Formas in cooperation with the Academy of Finland, VINNOVA and the National Technology Agency of Finland (TEKES) in the field of Wood Material Science is a good example of this type of cooperation. Durability and whole life aspects as well as other quality requirements, health requirements and recycling and environmental aspects should be taken into consideration. The way materials behave is governed by their properties, but also by the way in which different material types collaborate with one another and with the surroundings, and by the age of the material. New materials such as recycled materials, fibres and composites, high strength steel and concrete, wood and brick, also necessitate knowledge about possible health and environmental risks.

### **Formas focuses research on**

- new smart materials
- durability and whole life properties
- the environmental and health risks of materials

**Formas focuses research on**

- the function and energy efficiency of buildings and civil engineering installations
- the way the built infrastructure of society affects, and is affected by, changes in the environment
- environmental risks associated with underground processes
- incentives and opportunities for the players of the construction sector to change to techniques and processes that contribute to a sustainable development

**Formas focuses research on**

- sustainable urban development
- the significance of different players for sustainable societal development

**Buildings and civil engineering installations**

Owing to the totality of its responsibility, Formas has a great potential for holistic overviews of the processes, flows and structures of society and the influence of these on environment and humans. The replacement value of buildings and installations is ca BSEK 6000. The annual resource consumption for the running and maintenance of these buildings and installations also amounts to substantial sums. Research and capacity building in this sector are therefore of great macroeconomic importance. Sustainable spatial planning requires not only knowledge of the function, properties and energy performance of buildings and installations, but also knowledge of their environmental impacts and the way they will be affected by future climate changes.

The incentives and opportunities for the many players in the construction sector to change to techniques and processes, which contribute to sustainable development is an important field of research. New forms of cooperation and new possibilities of utilising IT necessitate research. The way changed official regulations for the construction and management of community infrastructure affect, or can be expected to affect, this development is an important area. Formas considers that increased significance should be accorded to the research, which focuses on the technical infrastructure in the form of installations for water and sewerage, energy supply, transport and communications including IT.

Issues associated with land, water, geotechnics and civil engineering installations also have a strong coupling to the climate. Research into the consequences of climate change in the already built town, and the way systems and dimensions may have to be altered in new construction, is therefore of great importance.

Fundamental research into processes in soil, rock and groundwater is important for the development of better methods for the analysis and management of environmental risks connected with underground planning and construction. Research into pollution of land is urgently needed, and this is accentuated by the fact that new construction today increasingly occurs as infill development and on land that had previously been used for industrial activity.

**Urban development**

Sustainable societal development is highly dependent on the way our towns develop, since more and more people are concentrated in towns and urban regions. Urban development can involve health risks and a greater load on the environment, and at the same time it provides the potential for health enhancing and environmentally effective solutions. Urban research, both fundamental and multidisciplinary and system oriented research, has therefore assumed increased importance. In research, the town is seen as a system comprising many superimposed structures in the form of building development structure, transport structure, business structure and green structure, etc. Changed conditions for the development of towns and urban regions

have also brought about increased demand for interdisciplinary knowledge and competence. Many of the solutions are presumably to be found at the interface between the different areas of science.

Getting the different sustainability dimensions, ecological, economic and socio-cultural, to function together within the framework of urban development necessitates a systems approach and system thinking. Research on how social structures and systems for the change to sustainable development can be organised demands a greater knowledge base. The same applies to the significance of different players and their influence on the implementation of the proposed solutions produced through research.

### **Rural development**

The Swedish countryside is undergoing an intense and rapid process of change. Large population movements with continued depopulation in certain parts of thinly populated rural areas, and immigration into other areas and the expansion of these, pose new challenges for research. This demographic development also creates new problems of social and economic character, which must be taken into consideration, while at the same time the focus in rural activities moves from primary production to a broader rural perspective. Research should also capture the dynamics of these migration flows and the mobility between town and countryside. Some of the challenge consists in being able to make use of the new conditions for setting up businesses, tourism and establishing a home in the countryside.

In the opinion of Formas, research should come together to enable many different sciences to provide their views of the ongoing development and to link together town and countryside. There is a need for both thematic and methodical diversity, which can be developed into an interdisciplinary approach in which researchers from different disciplines jointly identify fields of research. Analysis of different types of transaction patterns between town and country is important, especially as a basis for the construction of models for rural development. Local knowledge is essential to establish an active social dialogue and to make research more relevant for different players in society. The aim should be to better understand, through analyses using multidisciplinary inputs, the relationships between macro and micro levels, and between the global, regional and local dynamics.

### **Multidisciplinary research**

#### **Formas shall promote multidisciplinary research**

It is a well established view today that several scientific disciplines must collaborate so that complex problems may be solved. In the field of the environment it is considered that it is the natural sciences, which often discover and formulate environmental problems, but when these are to be solved collaboration is required with other branches of science (technology,

#### **Formas focuses research on**

- population movements and their consequences
- the relationship between town and country
- integrated economic, social and physical spatial planning



social sciences and humanities). Humans are in most cases the cause of these environmental problems. This means that the solution of these problems also lies in human hands. To create an insight into the problems and to bring about new attitudes and behaviours and new techniques therefore requires collaboration among different fields of science. Formas also has a clear mandate from the government to promote multidisciplinary research in the course of its work.

In our discipline oriented research world, it is difficult to develop high class multidisciplinary research which must at the same time be based on high quality within the subject areas concerned. Formas wants to work actively for the promotion of the development of multidisciplinary research in the different areas. This can be done both by separate calls for research applications and by developing better methods for the analysis and evaluation of multidisciplinary projects. The facts that the qualification systems of universities are in practice often based on single disciplines are one problem, as is the lack of multidisciplinary journals of good scientific standard in some areas. In the work of Formas, the definition of multidisciplinary research is that it shall act as a bridge between the different scientific areas and disciplines. Within the concept of multidisciplinary research, several variants of collaboration can be discerned. The term multidisciplinary science means that an issue or a problem is elucidated from several different directions, but with weak theoretical and methodical integration. In interdisciplinary projects, on the other hand, there is a clear integration of theories, methods, conceptual systems and/or facts from two or more disciplines.

Multidisciplinary research may take the form of collaboration between different natural science disciplines, but it is often a matter of a joint effort by two or more researchers from different areas of science, such as natural and social sciences, the humanities and technology.

In this context, increasing attention is given to the way in which sustainable development is handled institutionally. This is a complex web of mutually dependent systems. The social instruments of control from national to global level, inclusive of the interaction between these, require research inputs of multidisciplinary character. One important part of this concerns the interactions between research and the policy world that utilises the results, and the dialogue in society regarding the insight of the general public into research issues and their involvement in these.

## Research information and communication

The overarching goal of research information and communication is to contribute to the creation of a society consisting of informed citizens capable of critical thinking. Knowledge is a prerequisite for growth and welfare in society. Knowledge in a broad sense is also the basis for the quality of life of individuals and for public participation. Scientific knowledge is essential if the public and politicians are to be able to form an opinion regarding future issues of critical importance, such as climate changes, population changes, technological development and, in particular, sustainable development.

The prospects for the development of research communication in Sweden are very favourable. There is both interest in research news and trust in researchers on the part of the media and the public; there is a high educational level, openness and transparency in the publicly financed research, and willingness for dialogue within the research community. But in spite of these prospects, which are favourable in an international comparison, this dialogue is under threat today, mainly because of the lack of resources for Swedish research.

### Communication – for greater trust

The rapid advance of research contributes to development and increased welfare, but it also gives rise to unease and doubt. It is therefore essential that there should be a well functioning dialogue among researchers, research funding agencies, the recipients of research results and a broad public concerning overarching research policy, ethics and issues to do with the relationship between research and society. Examples, which illustrate that the issues of research extend far beyond the scientific community, are research on genetically modified organisms (GMO), climate, energy issues and other issues where ethics and value judgments play a critical role.

The good trust, which the public and politicians today have in research, may however prove to be brittle. This is shown by international experiences regarding highly publicised phenomena, such as mad cow disease (BSE) and genetically modified organisms. Both the behaviour of researchers themselves and the lack of objectivity and sensationalism of the mass media can affect this trust. For a research council such as Formas, which supports both fundamental research and research undertaken in response to a perceived need, the trust placed in research by sectors/industries is of critical importance. If the business community gets the impression that Swedish research is of insufficiently high quality, or that it is concerned only with research that business does not regard as "useful" even in the long run, this would be serious.

### Formas accords priority to

- communication of research results so that they are applied and provide benefits for society
- creation of platforms for a dialogue between research and practice
- support for the third task of universities

### **Research communication - a matter of resources**

For the research councils and VINNOVA, the provision of research information is a specific part of their activity as laid down by the government and Riksdag. Within the research areas of Formas, researchers can freely compete for external funds for information. Researchers have a basically favourable attitude to communicating their research to groups outside the scientific community. Owing to changes in research finance, in combination with the expansion of higher education, the "third task" that forms part of the terms of reference of universities – to have external contacts and to provide information on their work - has become an extra task, which is accorded little importance. Communication with external funding agencies and cooperative partners works reasonably well, since this provides immediate incentive for the individual researchers also. But if he/she is to be able to prioritise work on communication with broad target groups, this needs incentive, time and resources.

Even though resources are of critical importance, there are other factors that are significant. One such issue is the appraisal of CVs when applications for teaching posts are considered. According to the University Ordinance, "ability to cooperate with society at large and to provide information on research and development work" is a point in favour of an applicant for a teaching post in the universities. There are no up to date studies to show to what extent this is taken into account in practice. It is however the general impression that work on research communication is only in exceptional cases accorded any importance when applications are considered.

There are also a number of structural obstacles. Owing to professionalisation and specialisation in the scientific community, there is an increasing gulf between science and the general public. Much of the popular educational tradition of the nineteenth century and the beginning of the twentieth century has been lost. The joint investment by the research forums, the research councils and VINNOVA in the campaign "The new biology" is an attempt to revive this tradition in new forms.

### **The communication strategy of Formas**

In cooperation with the players in the fields of the environment, agricultural industries and spatial planning, Formas shall be instrumental in ensuring that research based knowledge will be applied and prove useful, and in making the results of research easily accessible. The players within the sphere of responsibility of Formas are a highly diverse group with very different knowledge and competence needs. This places high demands on the information activity of Formas in developing and communicating the right product, to the right target group, at the right time, in the right way and at the right price. However, if research results are to have general application and practical use, this is absolutely essential. Priorities are based on human needs for knowledge. Within the framework of this overarching goal,

Formas accords priority to the production of popular scientific summaries and to giving the players in the fields of the environment, agricultural industries and spatial planning the research based knowledge, which they need to solve existing problems and to prevent future problems. On the other hand, Formas shall not be prescriptive.

Researchers are the key people in the work on research communication. Most researchers both want to, and can, work on research communication provided they have adequate conditions for this. In this respect, Formas can stimulate and support researchers by providing, in cooperation with other funding agencies, a good infrastructure and platforms for communication nationally and internationally. The research community is also an important target group where the responsibility of Formas for information can however be mainly limited to making current work on R&D programmes and information on ongoing research and research results readily available.

The mass media and other opinion formers such as politicians and non-profit making organisations are strategic players. Through these, r&d results can be made visible to a broad public, and a market can be created for the results. The interest of the media for research news has appreciably increased in recent years, and surveys (Eurobarometer) indicate that the media, primarily TV, is the most important channel for research communication to the general public.



**Formas endeavours to bring about a well balanced distribution of research resources with**

- the emphasis on researcher influence where the approval rate should be increased
- special programmes in priority areas
- long term strategic investments in strong research environments
- support for young researchers and postdoctoral research centres

## The conditions and needs for the fields of research of Formas

### The forms of support from Formas

The opportunities that Formas has to realise the intentions of the research strategy depend to a large extent on the forms of research support that are established. It is essential to create favourable conditions for the researcher community so that it may exert an influence on research priorities and the allocation of funds. Formas also has a responsibility for the development of innovative and forward-looking research ideas and new approaches.

The research supported by Formas shall be of high quality and shall, where appropriate, be relevant for the sectors concerned. The preparation process, which has been established for the assessment of applications, with a majority of scientifically well-qualified researchers, secures quality assurance. When research of a more applied nature is to be assessed, its relevance shall also be ensured. In most cases, this is done through the participation of representatives of the industries concerned in the preparation process. The preparation process is evaluated after each round of applications and adapted to the demands posed by the work. This regular review will continue.

### The balance struck between different forms of support

In the continuous analysis of research needs in different areas, Formas must decide which form of support shall be given to each area so that the needs of research and society may be best satisfied. The principles governing the choice of the form of support for different areas at a certain time must gradually develop as a result of the Council's active work. It is natural for the different forms of support to vary within and among areas and over time.

In assessing the different forms of support, the Council must strike a suitable balance between the proportion of "free" funds and the proportion of programme-related funds. Formas makes strategic inputs by inviting applications for research funds within prioritised areas. It is the practice of Formas to formulate the broadest possible frameworks for the areas where applications are invited so as to promote diversity and innovative ideas from the research community.

### The pressure of applications and approval rate

At present, Formas calls for applications for about 65-70percent of research funds in a major annual call within all its research areas. This means that the project applications received are the researchers' own priorities and ideas. So far, about 1300 applications have been received annually in response to this call.

The approval rate, measured as the relationship between the number of applications and approved applications, or that between funds applied for and granted, gives an idea of the demand for Formas funds. In 2001 and 2002, only about 20 percent of the total number of applications could be approved. The corresponding figures for funds granted during these two years were 13.3 percent and 16.1 percent. This means that a large number of projects of very high scientific quality could not be financed. There is thus a great need for further funds for the annual call for "free" funds.

### Support for strong research environments

Within the areas of responsibility of Formas, there is a need to develop forms of support to promote strong research environments. The creation and maintenance of strong and internationally competitive national research environments demands collaboration within the entire research funding system. This means that a concentrated effort should be made in collaboration with other funding agencies, and also with universities.

On the one hand, Formas shall be conscious of the responsibility to ensure that research of high quality is carried out in all research areas, and on the other hand it shall invest in the best possible researchers. Both these approaches are necessary to guarantee diversity and to make it possible for new ideas to be tested, and to endeavour to ensure that Swedish research is at the forefront in an international perspective. Today, the approval rate for applications for the open funds is unacceptably low. There is some variation between research areas, but the picture is very similar over all the areas of Formas. If Formas is to be able to continue its work in the same way as up to now, this means that a greater investment in strong research environments must in the first hand be financed through an enlarged budget.

### Support for young researchers

The regeneration of research is of fundamental importance and is the mainspring for development. Different forms of support for young researchers are one way of meeting the requirement for regeneration of research, and at the same time they contribute to the solution of the problems associated with the imminent generation shift within Swedish research. The term young researcher refers to a person who has been awarded a doctorate within the past five years. In about half the projects, which have been approved, the funds are granted for postgraduate students and research assistants. In addition, special calls have been made for applications regarding postdoctoral research centres within the areas of responsibility of Formas.

As part of the ordinary project support, Formas allocates funds for posts for postgraduate students. When making investments in particular subjects, Formas can make use of the opportunity for earmarked investments in postgraduate students by prescribing that a certain number of postgraduate students shall be financed within the framework of the allocated funds. For instance, special investments in postdoctoral research centres have been made



within the framework of the research programmes for organic production and biodiversity. Investments in research assistant posts, which, according to the Ordinance, are mainly intended for young researchers, make up part of the ordinary project support. Formas will carefully balance the need for postgraduate posts against the need for support for employment as research assistants. The aim of this is to better meet the actual conditions and needs to be found in different research areas. The opportunity Formas has to invite applications for special researcher posts means that targeted inputs can be made in certain areas. This form of employment provides a unique opportunity for researchers – who are often young – to develop in their field over a period. This is of benefit for both their own careers and their discipline as a whole.

Post-doc stipends for researchers who have recently received their doctorates are another form of support for young researchers. Through stipends of this kind, Formas contributes to increased mobility within the research world, especially internationally. The Council will give careful consideration to the design of this form of support, especially with regard to the family situation of young researchers.

## Overarching issues associated with Formas' support for research

Factors to be considered in distributing support are

- equal opportunities and gender perspectives
- ethical and legal issues
- evaluation results

### **Equal opportunities and gender perspectives in research**

In most of the research areas financed by Formas, there is strong dominance by men. There are a few areas, which are exceptions from this rule. Of the researchers who apply for funds from Formas, about 27 percent are women, and so far the frequency of approved projects has been in proportion to the proportion of female applicants. These figures refer to the main applicants for a project. Gender distribution within the projects is not known. Formas intends to actively note whether the frequency of projects approved to women is in proportion to the proportion of female main applicants. The intention is to counteract, at different stages of application processing, downgrading of priorities due to gender related factors.

Formas promotes research with a gender perspective in areas where this is relevant. Applications from researchers who apply a gender perspective in their research are given a special welcome. This area will be given greater attention over the next few years, inter alia by investigating the need for special invitations for applications with this orientation.

### **Ethical aspects**

Ethical issues are assuming increasing importance in research. In several of the Formas areas there are studies concerning humans, animals and plants. Questions may be raised concerning the application of different methods where both the integrity of humans and the wellbeing of animals may be affected in different ways or where individual species or ecosystems may be under threat. Formas will continue its work on developing views regarding the research ethical issues and the attitude regarding these, both internally within the Council and in cooperation with the other research councils.

### **Exchange of biological materials across national frontiers**

Formas intends to develop a procedure for the responsibility the council has regarding geopolitical/ legal agreements concerning international cooperation within mainly genetics/plant improvement and the import and export of organic materials/knowledge between different countries and Sweden.

### **Evaluations**

Formas shall continuously evaluate research, which receives support. These evaluations form the basis for determining the quality and usefulness of Swedish research in a national and international perspective. They are carried out by external committees of international composition, which shall consider and assess scientific quality and the relevance of research results for the sectors concerned. Formas intends to continue its work on systematic evaluations over the coming years, in order to ensure that Swedish research continues to be of high quality.

## The need of Formas for funding over the period 2005-2008

Research is assuming increasing importance in society, and scientifically based knowledge is an important condition for sustainable development. Sweden is one of the countries in the world, which has traditionally allocated the highest proportion of its GNP for research and development. Most of the research takes places at universities and is almost entirely financed by the state. The number of people awarded doctorates has greatly increased, which means that research funds which have remained at the same level have had to be distributed to a greater number of people and projects, with the consequence that individual research projects have tended to be underfinanced. At the same time, the approval rate within the research areas of Formas has in recent years assumed an unacceptably low level, with only 15-20 percent of the number of applications being funded. Many research applications of very high scientific quality and relevance could not be financed. The aim is that it should be possible to finance about 30 percent of applications.

An increasingly globalised world demands more knowledge on how democracy, welfare and human rights can be secured. The serious environmental threats such as the issue of climate require large international investments and developed research cooperation between countries. Sweden must contribute to the global fund of knowledge with internationally outstanding research, in order that new and urgent knowledge may be developed in these and other areas. Sweden should also in other respects have the capability to be a resource-strong partner in research cooperation with developing countries.

In order to make use of the full potential of the Swedish research system and to meet the challenges of the future, with the aim that Sweden should continue to be a leading research nation where research contributes to economic growth and sustainable development, the government and Riksdag must over the coming years allocate greatly increased resources to the research system.

The spheres of responsibility of Formas cover some of the most important sectors in Sweden. The construction and property sector is the largest business in Sweden, with an estimated total turnover of almost BSEK 400 annually. The built environment accounts for over 40 percent of energy use in the country, and causes more than half the environmental load in society. The sector employs over 230,000 people. Forestry has a total annual export value of BSEK 110 and employs 100,000 people directly and another 100,000 indirectly, many of these in thinly populated areas. The food industry – the fourth largest industry with respect to the number of employees – directly employs 60,000 people. The entire food sector employs a further

190,000 people both directly and indirectly. Its export value is BSEK 27 and has increased by more than 150 percent since the accession to the EU.

On its creation in 2001, Formas assumed the existing responsibilities and research grants from the Swedish Council for Forestry and Agricultural Research (SJFR), the Swedish Council for Building Research (BFR), parts of the research grants of the Swedish Environmental Protection Agency, and an earmarked grant from the Swedish Council for Planning and Coordination in Research (FRN) which related to Swedish membership of IIASA. At the time of its establishment Formas received MSEK 20 for multidisciplinary research (2002-2003) and MSEK 63 for research on organic production (2001-2003). After this Formas was allocated MSEK 230 for research into biodiversity and sustainable development (2002-2004) and MSEK 10 for marine environmental research (2003). At present, the annual research allocation to Formas is ca MSEK 540, which is 2.6 percent of the total state allocation for R&D.

In order to satisfy the need for adequate finance for the best research in support of sustainable societal development and economic growth, Formas has identified a need for financial augmentation amounting to a total of MSEK 400 annually.

### **This augmentation comprises**

- An increase in the support directly distributed to individual research projects by MSEK 200 annually. This includes support for postgraduate and research assistant posts in order that more young researchers should be recruited. This increase in resources is essential to retain an important breadth in research funding and at the same time to enable researchers to embark on a search for knowledge of their own choosing
- An increase by MSEK 40 annually to enable a concentrated investment to be made in strong and internationally competitive research environments
- A special input of MSEK 50 annually to build up investments in multidisciplinary programmes. This refers in particular to interdisciplinary inputs to increase knowledge of the obstacles that counteract a sustainable societal development
- An increase by MSEK 20 annually for urgent research into the effect of climate change on sustainable development, within the framework of a national research programme
- An increase by MSEK 40 annually for fundamental research in the field of environmental toxicology, within the framework of a national research programme
- An increase by MSEK 50 annually for research into customised foods and the quality and safety of raw materials, within the framework of a national research programme

In our opinion, these investments are essential if Sweden is to live up to its reputation as a prominent research nation. Unless the research system is allocated more resources, Formas will be obliged to apply more stringent priorities to research resources. Within the broad field of responsibility of Formas, such more stringent priorities can in the long term result in a steep reduction in research or its complete cessation in some areas of research. This is a risky strategy since it is impossible to know in advance which research areas may become important in future. However, the most important reason for an increase in research resources is that the future of Sweden and our base industries is intimately associated with continued growth, which is in turn dependent on whether Swedish research is able to compete in an increasingly knowledge based and global economy.





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