

ANNEX B9

PITA Project: Policy Influences on Technology for Agriculture:  
Chemicals, Biotechnology and Seeds

## German National Policy

Objective I Report

Annex B 9

TSER Programme  
European Commission - DG XII  
Project No. PL 97/1280  
Contract No. SOE1-CT97-1068

**Matthias Hocke**

**MERIT**

**The Netherlands**

**December 2000**

## Introduction to the PITA Project

Technological innovation in the agrochemical, biotechnology and seeds industries and in associated public sector research establishments (PSREs) has the potential to deliver more socially and environmentally sustainable farming systems and to improve the quality of life of citizens in Europe. This is particularly true of farms on the most fertile land. However, although policies developed in different areas may all aim to improve the quality of life, in practice, in their influence on company and PSRE strategies, they frequently counteract one another and so attenuate the desired effect.

Market-related factors also influence decision making in industry and PSREs, the most important for this project being the policies of food processors and distributors and also public attitudes and opinion, which often set more demanding standards than those of national governments and the EU.

The PITA project (see Project Structure) is developing an integrated analysis of policies and market-related factors relevant to the agrochemical, biotechnology and seeds sectors. The core of the project is an investigation of the impact of these factors on the strategies and decision making of companies and PSREs and the downstream implications of these decisions on employment, international competitiveness and environmental benefits. The final outcome will be feedback of our conclusions to policy makers and company managers.

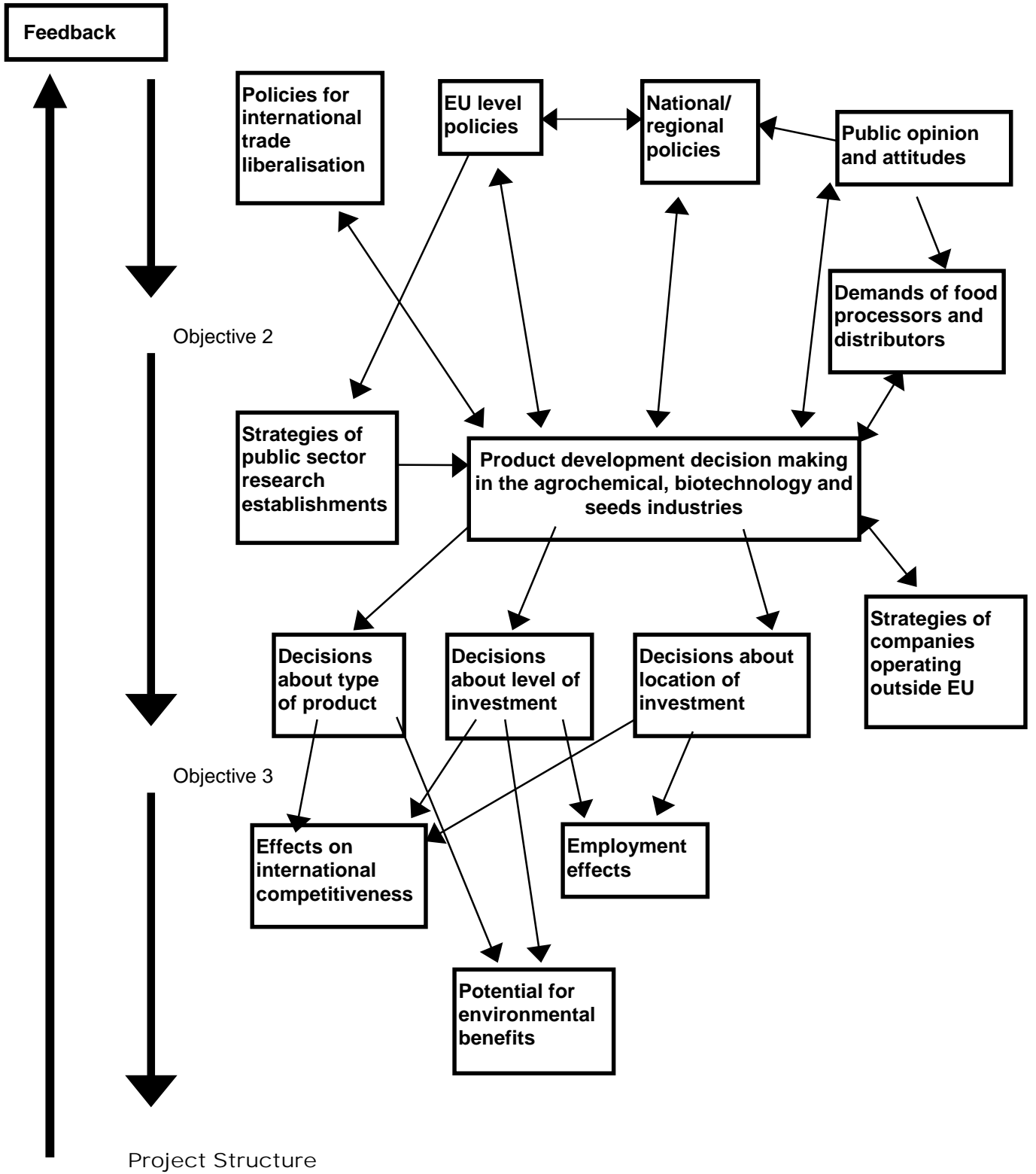
The range of policies and other influences studied includes:

- policies to stimulate innovation in the agrochemical, biotechnology and seeds industries;
- purchasing policies of food processors and distributors;
- policies for international trade liberalisation;
- policies for the regulation of industry and farming (for environmental protection and public health and safety, particularly for pesticides and biotechnology);
- agricultural and farming support policies, particularly for crop production;
- policies to promote environmental sustainability and wildlife biodiversity in arable farming areas;
- public opinion and attitudes.

The overall aim of the project is to contribute to the development of sustainable industrial and farming systems and an improved quality of life by encouraging the development and uptake of 'cleaner' technology for intensive agriculture. Its objectives are:

- to develop an integrated analysis of policies and market-related factors relevant to technological innovation in the agrochemical, biotechnology and seeds sectors, to study their interactions and to develop hypotheses about their impact on strategic decision making in industry and PSREs.
- to study the influence of policies and market-related factors on innovation strategies in the agrochemical, biotechnology and seeds industries and PSREs, and their impact on decisions about product development, levels of investment and location of investment.
- to study the outcomes of the industry decisions investigated under objective 2, in their effects on employment, on international competitiveness and on their potential to deliver environmental benefits.

Objective 1



## **Contents**

<b>1. INTRODUCTION</b>	<b>5</b>
<b>2. OVERALL FRAMEWORK FOR BIOTECHNOLOGY POLICY</b>	<b>5</b>
<b>3. POLICIES TO STIMULATE BIOTECH INNOVATION</b>	<b>6</b>
<b>4. CURRENT ACTIONS AND PROGRAMMES</b>	<b>7</b>
<b>4.1 BIOTECHNOLOGY</b>	<b>7</b>
<b>4.2 AGRICULTURE AND FARM SUPPORT POLICIES</b>	<b>10</b>
<b>4.3 NATIONAL POLICIES FOR ENVIRONMENTAL PROTECTION</b>	<b>12</b>
<b>4.4 STRATEGIES FOR SUSTAINABLE AGRICULTURE</b>	<b>12</b>
<b>5. CONCLUSIONS</b>	<b>14</b>
<b>REFERENCES</b>	<b>16</b>
<b>APPENDIX I</b>	<b>18</b>
<b>INTERVIEWS</b>	<b>18</b>
<b>APPENDIX II</b>	<b>19</b>
<b>PROGRAMMES FUNDED BY BIOTECH 2000</b>	<b>19</b>
<b>APPENDIX III</b>	<b>21</b>
<b>ABBREVIATIONS</b>	<b>21</b>

## 1. Introduction

This report gives an overview of government policies and programmes that can influence innovation in agricultural biotechnology (ag-bio) and seeds industries in Germany. Several levels of German government follow a relatively interventionist path to promote the establishment and growth of biotechnology expertise.

## 2. Overall framework for biotechnology policy

An important aspect of the German state structure that influences economic and environmental policy is the relatively large power of the 16 Länder or states. Germany's political responsibility is divided between the Federal Government and the Länder, which are very different from each other in size, population and wealth. The consequence of this situation is intensive political debates and long delays in political decision making, which also affects biotechnology policy. Nevertheless, regional and federal schemes to support biotechnology are seldom in conflict and regional initiatives are often absorbed into federal programmes in a straightforward manner (Cooke, 1999).

Due to the division of political responsibilities between the Federal Government and the Länder, the former mainly funds research facilities that are not linked to universities, such as the Helmholtz Gemeinschaft deutscher Forschungszentren (HGF), Max-Planck-Gesellschaft (MPG) and Fraunhofer Gesellschaft (FhG) institutes, whereas the Länder funds are mostly focused on universities.

With regard to innovation policies, we can classify the responsibilities of the states into six categories:

- Education, especially universities and technical academies (Fachhochschulen).
- Research institutes (jointly with the federal government).
- Transfer of information, technologies and employees.
- Promotion of the setting up of new business enterprises.
- Financing of research and/or start-up companies.
- Promoting co-operation within the region.

Two recent political developments are relevant to biotechnology policy and sustainable agriculture. First, the reunification of Germany with the former German Democratic Republic (GDR) in 1990 served as a starting point to change R&D policies towards giving ecological goals greater prominence in order to ensure the environmental sustainability of economic development (Kirkpatrick 1999). This was mainly inspired by the need to repair environmental damage in the former East Germany. Second, the September 1998 Federal election result brought a SPD/Green coalition into power, which is expected to place more emphasis on environmental issues. The entry of the Green party into the government also raised concerns among the biotechnology industry, given the Green party's longstanding opposition to biotechnology.

The new SPD/Green coalition government introduced a new agreement, in October 1998, on Biopolicy. A few selections from this policy are given in Box 1. The relevant sections for Agbio and sustainable agriculture stress the use of biotechnology for environmentally friendly purposes, research into the safety and risks of Agbio, and long-term scientific monitoring of GMOs. In addition, the agreement notes that 'alternative processes and strategies' also deserve support, although these 'alternative processes' are not defined.

**Box 1**

*“...Biotech processes open up new possibilities and opportunities for cleaning up the environment in an environmentally friendly manner and can help to transform toxins into harmless substances or replace them with harmless products. The extent of measures necessary to prevent hazards and risks remains controversial – in agriculture and the food industry in particular, questions are being asked about their usefulness to society. The new Federal Government will systematically develop the responsible potential for innovations in biotechnology and genetic engineering. Alternative processes and strategies must be given appropriate scope.”*

- *The priority status of protection of Mankind and the environment must be safeguarded in German and European law on genetic engineering.*
- *We shall lend our support to the maintenance of biodiversity and appropriate safety regulations in the global negotiations on the Biosafety Protocol.*
- *Field trials and the marketing of genetically modified organisms must be accompanied by long-term scientific monitoring due to the long-term effects of cultivating transgenic plants.*
- *We shall increase research into safety and risks; negative repercussions arising from use of antibiotics-resistant genes must be prevented.*
- *We shall re-examine the competencies for licensing the release and marketing of genetically modified organisms.*
- *We shall focus particularly on research into the social, ethical and legal implications of the application of modern biotech and genetic engineering procedures to humans, especially research into the human genome.*
- *We shall ensure that citizens are protected against genetic discrimination particularly in the field of health and life insurance.*
- *We shall ensure those products and processes, which have not been subject to genetic engineering, are labeled accordingly and can be clearly identified by consumers.*

*Germany will lend its support to high environmental quality targets in international agreements and will introduce action objectives, which allow internationally coordinated steps along a long-term path with appropriate instruments and thus have positive effects on international competition. We shall endeavor to harmonize environmental regulations at a high level within the EU. We should like to see international agreements against environmental dumping.*

### 3. Policies to stimulate biotech innovation<sup>1</sup>

The first advisory group on biotechnology was set up in 1970 by DECHEMA<sup>2</sup>, Germany's largest non-profit organization in biotechnology. In 1972 the Federal Ministry of Research and Technology requested the first study on biotechnology in Germany to be performed under the supervision of DECHEMA. The first national Institute for Biotechnology was established in 1976. Nearly 184 million euros were budgeted by the Federal Government between 1971 and 1978 for funding biotechnology. The first regulations on gene technology were passed in 1978, and a year later a separate unit for biological Research and Technology was set up at

<sup>1</sup> Sources: Warmuth 1991, BMBF 1996, Reiss and Giessler 1999, Cantley 1995.

<sup>2</sup> Deutsche Gesellschaft für Chemisches Apparatewesen, Chemische Technik und Biologie e.V.

the Federal Ministry of Education and Research. The years between 1979 and 1983 marked the first execution period for a pre-biotechnology programme by the Federal Government. In 1985 the Federal Government passed the first biotechnology programme called "Applied biology and biotechnology", with a budget of 0.51 billion euros. The German Genetec-Law and Safety Implementation Decree together with the "Biotechnology 2000" programme were passed in 1990. The first amendment of the German Genetec-Law and Revised Version of the Safety Implementation Decree was approved in 1993. The "BioRegio competition" was launched in 1995. In this year, Chancellor Kohl asked the Research, Technology and Innovation council to act as an advisor to the Government on the development and importance of bioscience. Current actions and programmes are described in the next section.

## 4. Current actions and programmes

The Federal Government's research and technology schemes are currently classified into 23 "funding areas", labeled between "A" and "Z". These funding areas cover the research and development activities of all ministries and government departments as well as project funding, basic (statutory) funding of institutions, federal university-related funding, and international co-operation.

The following section focuses only on programme areas of direct relevance to agro-chemicals and agro-biotechnology. The data is derived from the *1998 Report of the Federal Government on Research*.

### 4.1 Biotechnology

The purpose of funding area K (Biotechnology) is to extend the scientific basis and push technological development. After the change of government in 1998, the programme was restructured to "increase transparency and to improve control mechanisms". The restructuring has had two main impacts. First, technical support staff are being reduced through attrition at Government laboratories such as the Federal Agriculture Research Centre and the Federal Centre for Breeding Research on Cultivated Plants (BAZ), although there has been no reduction in academic staff, who are expected to produce 'more with less'. Second, there has been an increasing emphasis on communicating research results through publicizing reports and encouraging the use of the Internet.

As indicated before, many Länder support their own programmes, which are location specific. This means that research must be done in the Länder for applicants to be eligible for funding.

#### *Biotechnology 2000*

This is the priority program, dating from 1990, of the Ministry of Education, Science, Research and Technology. It is currently funded at 168.7 million euros per year. It also serves as the umbrella programme for related projects. It aims to encourage companies, higher education institutes, and R&D establishments to undertake collaborative research and development projects in a wide variety of fields within biotechnology. It supplies funding for both university and research institutes and for the Helmholtz Society Research Centers (90% federal and 10% state funds) and Leibnitz Institutes (50% federal and 50% state funds). According to one source within the Project Management Organization for Biology, Energy and Environment (BEO), the project is under re-evaluation and will be reorganized substantially by the end of March 2000<sup>3</sup>. The main thrust of the reorganisation was to distribute research funding more evenly throughout Germany. This contrasts with the previous emphasis on building up regional centres of biotechnology expertise. One of the outcomes of the reorganisation is the Bio-Profile project (see below).

---

<sup>3</sup> personal communication, Dr. Koch

Under Biotechnology 2000, SMEs and companies in the former East Germany<sup>4</sup> can receive a subsidy of up to 60% for R&D expenses, material, personnel, third party services, travel, and depreciation on project-specific equipment. In total, five federal ministries are involved in this project<sup>5</sup>. The Biology, Energy and Ecology (BEO) Research center in Jülich is responsible for the intermediary R&D management and coordination of this programme.

The priority areas for funding include: BioMethods (replacement of animal testing, biological safety research), BioMatter (bioinformatics, biological structures), BioSystems (environmental biotechnology, neurobiology), BioProduction (plant breeding, plant protection), Human Genome Research (exploration of the human genetic code), Plant Genome project (agrobiotechnology, plant breeding, transfer of knowledge), BioChance (research sponsorship for young companies), BioProfile (regional competition) and, BioFuture (competition to sponsor basic innovations).

Table 1 summarizes the relevance of each programme to ag-bio and gives the amount of funding in each priority area. (A brief description of priority areas that are of minor relevance to ag-bio is given in Appendix A.) Between 1995 and 2000, approximately 76.7 million euros, or 27% of the Biotech 2000 project budget was for programmes with "substantial" relevance to Agbio. This has increased to 92 million euros or 32% of current funding up to 2006. The three programmes of major importance to ag-bio are bio-production, the plant genome project, and bio-profile.

Table 1 Distribution of Biotech 2000 funds by programme (million euros)

Programme	1998	1999	Total funding <sup>1</sup>	Duration	Relevance to Ag-bio <sup>2</sup>
<i>Programmes due to end in 2000<sup>3</sup></i>					
BioMethods	9.5	10.2	51.12	1995 - 2000	×
BioMatter	18.1	20.45	102.25	1995 - 2000	×
BioSystems	14.7	10.2	51.12	1995 - 2000	×
BioProduction	26.3	15.33	76.69	1995 - 2000	××
<i>Programmes running past 2000</i>					
Human Genome Project	20.45	20.45	102.25	1995 - 2003	×
Plant Genome Project	-	5.11	40.9	1998 - 2006	××
BioChance	-	6.13	51.12	1999 - 2004	×
BioProfile	-	-	51.12	2001 - 2006	××
BioFuture	0.1	0.3	40.9	1998 - 2003	×

Source: Compiled from data available through BEO

1) Total over the lifetime of the priority area

2) × = Minor relevance to ag-bio, ×× = Substantial relevance

3) Many of the elements of these programmes will be incorporated into the programmes running past 2000

### *Bio-production*

This programme supports research to integrate biological principles into technical production processes. Its focus is to improve the output characteristics of crop plants, for example by

<sup>4</sup> Mecklenburg Vorpommern, Brandenburg, Sachsen Anhalt, Sachsen, and Thüringen

<sup>5</sup> The Federal Ministry of Education and Research (BMBF), of which the Biotechnology Division is in charge of implementing the project, the Federal Ministry of Food, Agriculture and Forestry (BML), the Federal Ministry of Environment (BMU), the Federal Ministry of Economics and Technology (BMW) and the Federal Ministry of Health (BMG).

applying molecular biology methods such as activating endogenous and exogenous biological defense potentials to produce healthy crop plants. This programme also acts as a promoter of the Jena BioRegio (bioinstruments).

#### *Plant Genome Project*

In order to keep up with the increasing demand for agricultural products while still protecting the environment and ensuring the safety, security and diversity of the food supply, the Plant Genome Project was established in late 1999 under the umbrella of the Biotechnology 2000 programme. For 1999, 5.11 million euros was allotted to this project. The primary objective is to gain insight into the structure and function of the genomes of the most important agricultural plants and to apply this knowledge to plant breeding, agrobiotechnology, the food sector and human health. Both firms and PSREs are eligible to apply for funding under this programme.

#### *Bio-Profile*

Launched in November 1999, this project is an addendum to the BioChance programme (see Appendix A). 51.12 million euros are earmarked for a period of 5 years. It is tied to the knowledge and results gained during the BioRegio competition, but is focused particularly towards those regions which have strengths in promising areas of application in modern biotechnology, with an emphasis on plant biotechnology. These strengths should be identified and converted in a targeted way into new products, production processes and services. According to the sponsorship guidelines, the first application round ends in March 2000 with a preliminary selection process of 20 projects by June 2000. By the end of May 2001, the three best applications will be awarded. Both firms and PSREs are eligible to apply.

#### *BioRegio-Competition*

This project was implemented in 1997 and supports regional clusters of expertise in the field of biotechnology. The goal is to foster the translation of biotechnological knowledge into products, production processes and services, thereby creating successful and outstanding centers of excellence in biotechnological research and application in Germany. Seventeen regions participated in the contest and three winning regions, selected by an independent jury of experts from academia, business and industry, were chosen as model regions: the Rheinland (Cologne, Düsseldorf, Wuppertal, Aachen), the Rhein-Neckar triangle (Heidelberg, Ludwigshafen, Mannheim) and Munich. The East German region of Jena was funded with a smaller grant. The programme is based on a systemic approach that supports all relevant aspects for encouraging the commercialization of biotechnology research: technology, patenting, financing, management, and marketing.

Over a five-year period, from 1997 onwards, the three regions are receiving preferential funds of 25.56 million euros each. As a first result, 150 new biotechnology businesses were set up in the regions up to the spring of 1998 and over 286.32 million euros of private capital was invested in biotechnology in these regions.

According to Cooke (1999), the effect of the BioRegio competition can be summarized as followed:

- Growth in the supply of venture capital available to German biotech companies.
- An improved regulatory climate that has reduced the time for approval.
- Formalisation of networks to support start-up.

A significant policy conflict can be observed in the trend for companies to move their operations into the Bioregions, since this strengthens already strong economic regions. The BioProfile programme of the government, which funds biotechnology support, addresses this development by targeting new regions away from the already existing clusters.

Most of the policy support for biotechnology, including the funding for the Bio-regions and other government biotechnology programmes, concern pharmaceutical and health

applications of biotechnology. The variety of programmes for agricultural biotechnology, plus the level of funding, is comparatively limited.

## 4.2 Agriculture and farm support policies

In addition to the support of ag-bio research under various targeted biotechnology programmes, traditional agricultural programmes can influence the development of both ag-bio and sustainable agriculture. Most of the relevant programmes in Germany are managed by the Federal Ministry of Food, Agriculture and Forestry. Several goals of agricultural policy are relevant to sustainable agriculture:

- The support and development of a competitive and environmentally sound agriculture.
- The promotion of renewable resources, which have a particularly beneficial effect on the environment.
- The creation of employment alternatives in rural areas in order to support the agricultural sector during a period of structural change.
- The improvement of social security for farmers.

The most recent data on spending for agricultural programmes is for 1998. Together, the Federal Government and the Länder allocated 7.71 billion euros for all agricultural programmes in 1998. This represents a decrease of 2.6% compared to 1997. The majority of the funds, or 67.8%, went into grants for the social security of farmers and their families. Measures for improving the agricultural structure (i.e. premiums for ecologically compatible farm production and set-asides) consumed another 1.15 billion euros or 14.8% of the total budget. 0.4 billion euros went into a diesel-fuel subsidy, and 0.61 billion euros or 10.4% were spent on research on renewable resources, fisheries, and general administrative expenditures.

The most relevant funding areas for sustainable agriculture include the 1.15 billion euros spent on agricultural structure and the 0.61 billion euros spent on research and administration. Although a substantial fraction of these expenditures are unlikely to have much real relevance for sustainable agriculture, they dwarf the approximately 30.67 million euros that has been spent per year on biotechnology programmes with 'substantial' relevance to ag-bio.

Furthermore, the Federal Government spent 135.5 million euros on agricultural research in 1998 (under funding area R), an increase of 3.1% over 1997. The research focused on three objectives: (1) to develop and optimize agricultural production systems, (2) to improve socio-economic tools for policy and technology assessment and, (3) to improve systems to monitor long-term natural developments such as biological monitoring, climate change, biological diversity and livestock development.

The next two sections discuss two main agricultural policies that are of relevance to the Government's agro-environmental goals: increased support for a competitive and environmentally sound agriculture, and promoting the cultivation of renewable resources for use in the non-food-sector. Section 1.3.4 below focuses specifically on government policies that deal more directly with sustainable agriculture, including reducing fertiliser and pesticide use.

### *Competitive agriculture*

According to the Secretary of Agriculture, current government policy must ensure that German agriculture is fully competitive on world-markets. In the case of structural policy, this means concentrating support on the regions with the weakest economies (new Länder) by fostering employment promotion criteria. An orientation towards world markets is accomplished by reducing the subsidies for agricultural goods and implementing measures to increase productivity. A policy conflict can be seen in the fact that these measures have not been very satisfactory because agriculture by itself is region- and area-specific. This means the overall policy of "competitiveness" is not applicable to all areas, due to quality differences

of soil and climate. According to the Greenpeace agro-expert<sup>6</sup> in Germany, a more selective approach that takes into consideration the strengths and weaknesses of regions would be more appropriate.

This issue has also been addressed recently by the federal government. According to Bergschmitt et al. (1999), the assessment of agro-environmental measures revealed deficiencies, particularly the methods used to evaluate effectiveness and efficiency. These weaknesses were attributed to inadequate specification and quantification of goals in the programme planning, methodological uncertainties in the evaluation of environmental impacts, and incomplete EU guidelines on the subject. More emphasis is placed now on regional and local programmes in environmentally sensitive areas, which differs from the previous approach of implementing standard measures across all of Germany.

#### *Renewable resources*

Since the beginning of the 1980s, the development of renewable resources has been intensively promoted by the federal government. Various initiatives have originated within agriculture, industry and the public sector to step up development in this field. The central coordinating agency in Germany, the FNR<sup>7</sup>, founded in 1993, is charged with ensuring a practice-, problem- and result- oriented pooling of activities for the support of renewable resources. The public sector promotes renewable resources at various levels.

The Federal Government promotes research and development at the national level through its "New Renewable Resources programme" (1996 – 2000). 28.63 million euros per year are currently available for this purpose. To improve the coordination of activities at the federal level, from January 1993 responsibility for this project has been assigned to the Federal Ministry of Food, Agriculture and Forestry. A faster market introduction is to be achieved by improved coordination

The Länder support research and development projects with a focus on regional interests. The amount of funding provided by the Länder varies widely, since projects are in part co-financed by the Länder and the Federal Government.

For the cultivation of renewable resources, an area of 500,000 hectares was reached in 1998. Due to an amendment to the Electricity Supply Act, biomass is now being promoted for power generation.

Table 2, gives the number of hectares between 1993 and 1999 that have been used for the cultivation of renewable resources on former set-aside areas in Germany that had been withdrawn from agricultural use. These resources are used in the industrial sector as lubricants, bio-diesel, and paper.

The total number of set-aside hectares that have been turned towards industrial crops has increased by 567% over these six years. Rape-seed accounted for 97.4% of the hectares in 1999, compared to 83% in 1994. With the exception of medicinal herbs, the number of hectares of other crops has declined from earlier peaks. For example, the number of hectares of flax seed declined from 4,755 in 1994 to 1,088 in 1999, while fiberplants declined from 272 hectares in 1995 to 37 in 1999. This suggests that there has been a sharp decline in the diversity of crops under cultivation for renewable resources. Although the use of crop plants for industrial applications could have net environmental benefits through a decline in the use of alternative industrial inputs (such as petroleum-based inputs), it is difficult to determine if the trend to return set-aside land to production furthers *agricultural* sustainability.

---

<sup>6</sup> Martin Hofstetter, personal communication

<sup>7</sup> Fachagentur Nachwachsender Rohstoffe e.V

Table 2 Hectares under cultivation for renewable resources in Germany

Resource	1993	1994	1995	1996	1997	1998	1999
Starch			2,700	60			
Rape-seed	60,406	132,745	330,523	226,915	106,149	143,270	362,722
Sunflower	258	14,094	17,176	6,662	3,068	3,120	6,999
Flax-seed	1,895	4,755	3,269	1,290	659	443	1,088
Fiberplants	9	20	272	28	21	24	37
Medicinal herbs	723	961	929	611	843	933	949
Others	2,408	8,152	5,930	1,056	205	318	642
Total	65,699	160,727	360,799	236,622	110,945	148,108	372,437

Source: Fachagentur für Nachwachsende Rohstoffe

#### *Other Developments*

An implementation of the federal Government's resolution to "reduce the number of, and streamline, federal authorities" implies that the federal research centers receiving basic funding from the government will have to reduce their personnel by 30% (from 3600 to 2600) by the year 2005. To this end, a framework concept was drafted which provides, among other things, for closing down several research centers (Institute for Microbiology and, the Institute for Clinical Virology, both in Tübingen) by combining institutes to form larger units. It is also planned to reduce capacities in production-oriented research, while slightly increasing those of socio-economic and environmentally relevant research

### 4.3 National policies for environmental protection

Environmental policies can be of relevance to sustainable agriculture. For this reason, several environmental policy areas with possible impacts on agriculture are evaluated below.

The priority policy areas of the Federal Ministry of the Environment, Nature Protection and Reactor Safety (BMU)<sup>8</sup> are:

- The ecological modernization for employment and the environment, mainly via new technologies combating the causes of environmental damage.
- Climate protection, reduction of CO<sub>2</sub> emissions by 25% from 1990 levels by 2005.
- Reform of the Environmental Law into an Environmental Code through economic incentives and increased public participation.
- Revision of the Federal Nature Conservation Act.

The Federal Governments' programme "Research for the environment", which was adopted in 1997 and funded with about 4.9 million euros in 1998, gives more weight to the areas of environmental care and the integration of environmental protection into production processes. The research plan can be subdivided into three areas: 1) ecological research with a funding volume of 14.26 million euros, 2) Environmental technologies, and 3) Climate and atmospheric research.

### 4.4 Strategies for sustainable agriculture

In Germany the principle of sustainability was embodied in the Basic Law (Grundgesetz) as a national goal in 1994 (Article 20 a, formulating the national objective of environmental protection). This amendment also emphasises the fact that securing a sustainable

---

<sup>8</sup> Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit

environment is not only a matter of environment policy, but a cross-sectional task of government action in general.

Article 20 a Basic Law: "The State, aware of its responsibility for present and future generations, shall protect the natural sources of life within the framework of the constitutional order through legislature and, in accordance with the law and principles of justice, the executive and the judiciary."

The following describes what form sustainability takes in the spheres of agriculture and which strategies for the transition to sustainability are being pursued in this sector.

Roughly 55 percent of the territory of the Federal Republic of Germany is used for agriculture. Of this, approximately 70 percent is arable land, and 50 percent of arable land is cultivated with cereals. Eighty percent of plant production in Germany is used as animal feed for meat production and dairy farming. In the 588,000 farms (1998) in Germany's agricultural sector, approximately 1.4 million persons, i.e. 3 percent of the total labour force, work in a full-time or part-time capacity<sup>9</sup>. In addition to its economic and regional significance, agriculture plays a central role in conserving and developing the historical landscape and its biological diversity. The goals of sustainable, environmentally sound agriculture in Germany comprise:

- Supplying the population with high-quality food at acceptable prices.
- Ensuring that the agricultural community has its share of rising incomes and wealth.
- Securing the natural foundations of life and preserving biological diversity.
- Conserving and developing rural areas.
- Improving foreign economic relations in the agricultural sector and the world food situation.

The objectives of environmental and structural policy in the countryside can be achieved if a balanced relationship is established between utilization and protection of the ecosystem. Agriculture - especially in a highly industrialized country like Germany – makes an important contribution to the development of closed substance cycles that ease the strain on resources. For example, about 25 to 30 percent of the total output of sewage sludge as well as considerable quantities of compost from biowaste collections are currently being recycled in agriculture. In this way, nutrients removed from the soil during food production are returned again in the closed substance cycles of farming. In order to reduce the possibility of associated harmful substances returning to the soil and causing potential long-term pollutant accumulations, limit values have been set by the Sewage Sludge Ordinance ( Klärschlammverordnung). A corresponding ordinance for compost is being prepared.

In the agriculture sector itself, intensive and locationally inappropriate farming is also causing environmental burdens:

- Chemical inputs from fertilization and plant protection damage groundwater and surface water regionally and locally. Nitrate inputs, especially via semi-liquid manure, lead to an excessive nutrient levels in the soils of some regions and to the disappearance of species unable to adapt.
- Spatially concentrated livestock farming contributes to air pollution (mainly through ammonia) and thus to forest damage and to eutrophication of low-nutrient ecosystems. Moreover, agriculture is responsible for a considerable proportion of the total German emissions of the greenhouse gases di-nitrogen oxide and methane (36 and 32 percent respectively). However, despite these relatively high shares, only 5 percent of overall greenhouse gas emissions in Germany are caused by agriculture.

---

<sup>9</sup> Report of the Government of the Federal Republic of Germany on Agriculture, 1998

## ANNEX B9

- Soil use inappropriate to local conditions lead to soil compaction and to gradual removal of the topsoil. Once commonly practiced measures such as ploughing up grassland, removing natural landscape features, or crop rotation between only two crops have also impaired the habitats of numerous wild animal and plant species.

Towards sustainable agriculture, the policy of the Federal Government is designed to establish greater compatibility between agricultural use and the protection of habitats. The main focuses are:

- The further reduction of pollutant inputs in all areas, in particular by applying plant protection agents and fertilizers in a technically proper and environmentally sound manner and by observing area-linked ceilings on livestock farming.
- Gentle soil cultivation to avoid compaction and soil erosion.
- The preservation and adequate interlinkage of natural and near-natural parts of the landscape, including agricultural areas.

The main thrust of efforts to create sustainable agriculture is, however, the continued improvement of the environmental compatibility of conventional farming, which will remain the predominant method in the future for reasons of productivity and profitability.

Conventional farming already complies with the standards for environmentally sound production. Special rules affecting agriculture are contained, above all, in the Fertilizer Act (Düngemittelgesetz), in the impending Soil Protection Act (Bodenschutzgesetz) and in the Federal Nature Conservation Act (Bundesnaturschutzgesetz).

The Fertilizer Act stipulates that fertilizers may only be applied in accordance with "good agricultural practice", i.e. geared to the nutrient requirement of crops. The last few years have seen a large decline in sales of nutrients in the form of commercial fertilizers. In the period 1988/89 to 1997/98, the quantity of phosphates sold fell 60 percent and nitrogen by 25 percent.

The Plant Protection Act (Pflanzenschutzgesetz) has led to more stringent regulations governing the approval and application of plant protection agents. In general, farmers are using agents with improved biodegradability (max. half-life 70 days) and a more selective action. The number of active ingredients in common use has declined from over 300 in the mid-1980s to fewer than 100 today. The number of licensed plant protection agents fell by roughly 50 percent between 1980 and 1991 (to 956). New licenses are generally granted for a period of 10 years.

The goal of the plant protection act is to limit use of chemical agents to a bare minimum. This restriction is backed up, among other things, by:

- Regulations governing phytosanitary measures and the use of healthy propagation materials.
- The obligations on the user to take into account the conditions pertaining in each application situation.
- Restrictions on the outdoor application of plant protection agents on crops.
- Ban on the use of plant protection agents near surface-waters and sea coasts.
- Regulations to ensure adequate competence of the users of plant protection agents as well as standards for plant protection equipment.

## 5. Conclusions

Both the Federal and state governments have made a concerted effort to improve biotechnology expertise in Germany. Most of the funding has gone to pharmaceutical and health applications, with only about 30.67 million euros per year going to programmes with a substantial emphasis on agricultural biotechnology. The three main Biotech 2000 programmes of relevance to ag-bio are Bio-production, the Plant Genome Project, and

## ANNEX B9

BioProfile. In addition, the BioRegio programme has supported the development of regional centres of biotechnology expertise.

There is no evidence so far to indicate that the programmes to support agricultural biotechnology have expressly focused on sustainable agriculture or environmental benefits, although these goals are included in the SPD/Green coalition's Biopolicy. Instead, the main thrust of government biotechnology policy has been to develop the necessary expertise for the development and production of commercially viable biotechnology products, although this policy has not been very successful. Germany has made substantial progress in biotechnology in recent years, but still lags behind the United States in most indicators of research, applications and the use of biotechnology (Giesecke, 2000).

National agricultural policies have similarly focused on improving the competitiveness of German agriculture. The main component of traditional agricultural policy with a possible benefit for sustainable agriculture is the programme to support the use of set-aside land to grow crops with industrial applications. However, it is not clear if this programme is providing net agricultural benefits, or if the environmental benefits are largely occurring in industry.

Two government policies to reduce fertiliser and pesticide use are of direct relevance to sustainable agriculture, although neither conflict with standard agricultural practice. This is partly because policies to support sustainable agriculture are subsumed under policies to improve competitiveness and a low-cost food supply.

## References

- Agriculture Report of the Federal Government 1999.
- Bundesanstalt für Züchtungsforschung an Kulturpflanzen – Jahresbericht der BAZ; ISSN 0948-745X.
- Cantley, M. F. (1995) 'The regulation of modern biotechnology: a historical and European perspective', pp.505-681, in H.-J. Rehm and G. Reed, eds, *Biotechnology: Legal, Economic and Ethical Dimensions*. Weinheim/New York: VCH.
- Coalition Agreement between the SPD and Alliance 90/The Greens, 20th October 1998.
- Cooke, P. (1999) *The German Biotechnology Sector, the Public Policy Impact and Regional Clustering: an Assessment*, Report commissioned by the Department of Trade and Industry, Biotechnology Directorate, Cardiff, England.
- Dankbar, B., Demand, I., Kemp, R. (1996) *Monitoring Technology Policy in Europe, the role of public research institutes*. Study for the Dutch Ministry of Economic Affairs, Maastricht, The Netherlands.
- Ernst & Young (1999) *European Life Sciences 99: Communicating Value*, London, Ernst & Young International.
- Eurobarometer 46.1 (1997) *European Opinions on Modern Biotechnology*, European Commission Directorate General XII, Science, Research and Development, Brussels.
- CEC (2000) *A User's Guide for Small and Medium Enterprises in the Biotechnology Field*, Brussels: Commission of the European Communities, DG III/E/2.
- Federal Ministry of Economics and Technology (1999) *Economic Report '99*, Berlin, Germany.
- Federal Ministry of Education and Research (1998) *Facts and Figures 1998: Report of the Federal Government on Research*, Bonn, Germany.
- Giesecke S. (2000) 'The contrasting roles of government in the development of the biotechnology industry in the US and Germany', *Research Policy* 29: 205-223.
- Giessler S. and Reiss T. (1999) *Inventory and analysis of biotech programmes and related activities in all countries participating in the Biotechnology Programme 1994-1998: National Report of Germany*, Fraunhofer Institute for Systems and Innovations Research (ISI), Karlsruhe, Germany.
- Kirkpatrick G. (1999) *Economic Survey of Germany, 1999, Policy Brief*, OECD.
- Licht, G. and Legler, H. (2000) *Zur technologischen Leistungsfähigkeit Deutschlands*, final report commissioned for the Federal Ministry of Education and Research, Berlin, Germany.
- Max-Planck-Gesellschaft (MPG) 1999, *Facts and Figures*.
- Peerenboom, E. (2000) 'German Health Minister calls time out for Bt maize', *Nature Biotechnology* 18.
- Rehfeld, D. (1995) 'Disintegration and reintegration of Production Clusters in the Ruhr Area', in P. Cooke (ed.) *The Rise of the Rustbelt*, London: UCL Press.
- Runci, P. (1999) *Energy R&D in Germany*, Report prepared for the U.S. Department of Energy under Contract DE-AC06-76RLO 1830
- Schitag, Ernst & Young (1998) *Germany's Biotechnology Takes Off in 1998*, First German Biotechnology Report, Stuttgart, Germany.
- Warmuth E. (1996) *Biotechnology R&D in Europe, National files for: Germany*. Brussels: European Commission Directorate General XII, Science, Research and Development.

ANNEX B9

Warmuth, E. (1991) 'Biotechnology 2000: a new German R&D programme', *Research Evaluation* 1(2): 77-88.



## Appendix I

### Interviews

Name	Organization	Location
Dr. Biehl	Project Management Organization Biotechnology, Energy, Ecology (BEO)	Jülich
Dr. Mertens	German Central Commission for Biological Safety	Berlin
Dr. Gent	Expert on agrobiotechnology at the DIB	Frankfurt
Dr. Koch	Project Management Organization Biotechnology, Energy, Ecology (BEO)	Jülich
Dipl. Bio. Otto	Federal Agricultural Research Centre (FAL)	Völkenrode
Prof. Poppinger	Faculty of Agriculture, Int. Rural development and Environmental Protection	Kassel
Dr. K. Peter	Federal Center for Breeding Research on Cultivated Plants	Quedlinburg
Dr. Klockner	Head of the German Association of Biotechnology Industry	Frankfurt
Dr. Berariu-Frische	Expert for biodiversity convention at the DIB	Frankfurt
M. Hofstetter	Agro Expert at Greenpeace	Hamburg

**APPENDIX II**

## Programmes funded by Biotech 2000

*BioMethods*

This programme focuses on biotechnology methods and processes such as the design and automation of parallel working steps in genome research. It encourages the development of better and reliable screening processes for natural compound research to identify interesting pharmaceutical structures. In order to replace animal testing new research methods and processes should be developed and it aims towards developing methods and processes for the safe use of organisms and biological techniques.

*BioMatter*

Mainly oriented towards information contained in biological matter this programme identifies information principles (biological laws) embodied in biomolecules (DNA, proteins, glycosides etc.) to create a basis for innovations in health and environmental protection, agriculture and industry. A second aspect is the development of a bioinformatics infrastructure.

*BioSystems*

This programme concentrates on the technical implementation of biological principles at the interfaces with physics, chemistry etc; self-organization of biological matter to form three-dimensional functional structures focusing on "Neuronal structures" (brain research) as a basis for innovations in information and communication technologies. It also stresses the importance for the development of biological processes to reduce environmental pollution and cleanup the environment.

*Human genome research*

By exploring the structure and function of the human genetic code this project, which emerged in 1995, looks for developments of new possibilities on how to fight severe diseases such as cancer, cardiovascular disorders and Alzheimer's disease. It also tries to establish new demand-driven technology transfer models. Compared to the UK and US relatively little sequencing data have yet emerged. In 1997 there has been a major alteration in the project structure. All structures needed for a new technology transfer model have been established under this project. Its main target now is the systematic and comprehensive patenting of research results, thus ensuring the efficient and target-oriented translation of these results into innovative products and services. Essential structural elements of this model are a patent and license agency and a central database. Current financial planning provides for about 102.25 million euros up to the year 2003.

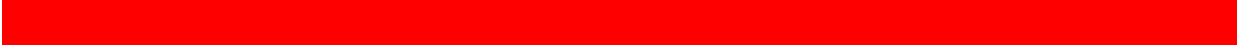
*BioChance*

This programme was funded in June 1999 with a budget of 51.12 million euros up to the year 2004. It aims specifically towards funding economically risky research projects of young biotech start-ups, which have not been in business for longer than 5 years. These projects should make a significant contribution to establishing these companies in the market place. Priority is given to applied research projects, which can be worked on jointly with universities and research institutions. The second objective of this project is to provide support during the development phase of products up until they are ready to be marketed. During the first selection round in September 1999, 46 project applications have been received, embracing very wide areas of biotechnology, ranging from medicine to renewable resources for which 6.13 million euros were awarded.

## ANNEX B9

### *BioFuture*

This project was announced in 1998 to promote and set up 50 new bioscience research groups with 350 jobs, of which 250 are to be occupied by academics. The project is to be funded at a scale of 76.69 million euros over a five-year period. The aim of this programme is twofold. First it could attract young promising scientists and second it could foster the development of new centers of excellence for basic innovations in bioscience. From 800 plus applications received in May 1998, 32 were selected (including 3 researchers from abroad) and are being supported with 40.9 million euros.



## APPENDIX III

## Abbreviations

BAZ	Bundesanstalt für Züchtungsforschung an Kulturpflanzen (Federal Centre for Breeding Research on Cultivated Plants)
BEO	Projekträger Biologie, Energie und Ökologie (Project Management Organization Biology, Energy, Environment)
BMBF	Bundesministerium für Bildung und Forschung (Federal Ministry of Education, Science, Research and Technology)
BMG	Bundesministerium für Gesundheit (Federal Ministry of Health)
BML	Bundesministerium für Ernährung, Landwirtschaft und Forsten (Federal Ministry of Food, Agriculture and Forestry)
BMU	Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Federal Ministry of Environment, Nature Protection and Reactor Safety)
DECHEMA	Deutsche Gesellschaft für Chemisches Apparatewesen, Chemische Technik und Biotechnologie e.V. (German Society for Chemical Apparatus, Chemical Technique and Biotechnology)
DIB	Deutsche Industrievereinigung Biotechnologie (German Association of Biotechnology Industries)
FAL	Bundesforschungsanstalt für Landwirtschaft (Federal Agricultural Research Centre)
FhG	Fraunhofer Gesellschaft (Fraunhofer Society)
FNR	Fachagentur Nachwachsender Rohstoffe ( Agency for the promotion of renewable resources)
GDR	German Democratic Republic
GMO	Genetically modified organism
HGF	Helmholtzgemeinschaft deutscher Forschungszentren (Helmholtz society)
MPG	Max-Planck-Gesellschaft (Max Planck Society)
NRW	North Rhine Westphalia
PSRE	Public sector research enterprise
TBG	Technologie-Beteiligungs-Gesellschaft (Technology Participation Company)
SME	Small and medium sized enterprises
SPD	German Socialdemocratic Party
VBU	Vereinigung deutscher Biotechnologieunternehmen (Association of German Biotechnology Companies)
VCI	Verband der Chemischen Industrie e.V. (Association of the Chemical Industry)
ZKBS	Zentrale Kommission für die Biologische Sicherheit (German Central Commission for Biological Safety)