ANNEX E6

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

Spanish PSREs in Agrochemicals, Seeds and Plant Biotechnology

Annex E6

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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

Feedback

Policies for international trade liberalisation
EU level policies
National/ regional policies
Public opinion and attitudes
Demands of food processors and distributors

Objective 2

Strategies of public sector research establishments
Product development decision making in the agrochemical, biotechnology and seeds industries

Decisions about type of product
Decisions about level of investment
Decisions about location of investment

Efforts on international competitiveness
Employment effects

Objective 3

Potential for environmental benefits

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1. **Introduction**

The objective of this study of Public Sector Research Establishments (PSREs) is to analyse the impact of policies and market-related factors on their strategies and decision making and their role in relation to public regulators and industry.

The range of policies and other influences studied includes: 1) science, technology and innovation policies; 2) environment, public health and biodiversity policies; 3) farming support and international trade policies; 4) public opinion and attitudes and market related factors.

In order to achieve this objective we have to answer the following research questions:

1. How important are PSREs in the national system of innovation?
2. Which PSREs in Spain are engaged in plant biotechnology, seeds (plant breeding) or agrochemicals (crop protection)?
3. What sort of activities is each PSRE engaged in?
4. How are the PSREs being funded?
5. What factors influence their R&D priorities?
6. How important is the environment in their R&D priorities?
7. How do they interact with industry?
8. What is their role in relation to public regulators?
9. Do the PSREs experience role conflicts (as providers of basic research, participants in technological programmes, providers of skilled labour for industry, supporters of regulatory bodies, and sources of independent expertise)?
10. How far are PSREs “open” to public policies?
11. What are their views on future prospects for biotechnology and agrochemicals in Europe?

Questions 1 to 4 are answered in Section 1, which presents an overview of the Spanish PSREs in agrochemicals, seeds and biotechnology. Section 2 describes the roles played by PSREs from a policy maker’s perspective. Questions 5 to 11 are answered in Section 3, which presents a case study of INIA and CNB. Our study is focused mainly on the INIA for several reasons. First, it is the largest national PSRE devoted only to agro-food research. Second, all its research units work in coordination with the same objectives and tasks. Third, this is the body that implements the farming research policy of the Spanish government through the Sectorial Agriculture and Food Research Plan. Finally, INIA is in charge of the Plant Varieties Registers in Spain.

2. **Organisation of Public Research in Agriculture and PSREs in Agrochemicals, Seeds and Biotechnology in Spain**

2.1 **The public system of research**

Since the *Law of University Reform* of 1983 and the *Law of Promotion and General Coordination of Scientific Research* of 1986 (named the Science Law) came into force, the Spanish public research system has undergone an important change. These two laws reinforced research activities in universities and were intended to coordinate the actions of R&D centres within the different ministries by means of the Inter-ministry Commission of Science and Technology (CICYT). The launching of the R&D National Plan (1988-1991, and
subsequent versions) implemented these laws. Since then, the R&D National Plan has been
the main instrument in Spanish R&D policy.

The public system of research (PSR) in Spain comprises 49 universities, which share 32.4%
of total national R&D expenditure and 41.1% of total R&D personnel, and the public research
institutes and other government laboratories, which represent 17.3% of total R&D
expenditure and 21.4% of total R&D personnel (CICYT, 2000).

We have to take into account some general characteristics of Spanish PSR in order to
understand the role played by PSREs in Spain, where agricultural research is not an
exception. In terms of the structure, organisation and nature of Spanish PSR:

• Research organisations and funding sources are highly varied and the degree of coordination
  between different bodies is quite low;
• PSR seems to function independently from other systems, in particular the economic and
  productive systems;
• There are continuous conflicts between sectoral, national and regional policies in relation to
  R&D;
• There are difficulties in defining priorities for PSR in Spain and there is limited experience of
  forecasting and evaluation;
• Spanish industry has played a very limited role in defining priorities and in technology
  forecasting. PSR operates from the "supply side" with scarcely any involvement from the
  "demand side", except in the case of some very specific activities and in the solution of some
  problems of very limited scope. (Muñoz, Santesmases and Espinosa de los Monteros, 1999.)

In order to overcome these difficulties, the Spanish government has launched a new R&D
policy whose main elements are the Fourth National Scientific Research, Development and
Technological Innovation Plan (2000-2003), approved in November 1999; and the Ministry of
Science and Technology (MCYT), created in May 2000, which unifies the policy-making
powers on scientific and technological policies and manages the public funds for R&D
activities. This new policy puts a clear emphasis on innovation and competitiveness through:

• an increase in the size and quality of the national system of science, technology and
  innovation, by means of public expenditure on R&D and stimulation of private investment in
  innovation
• improved use of the research activities by firms and the society
• the internationalisation of Spanish science and technology
• improved qualifications of the human resources in both the public and private sector
• increased level of scientific and technological knowledge of Spanish society
• improved co-ordination and assessment of public R&D policy (CICYT, 1999).

It is too early to assess the impact of this new policy and the role of the new MCYT. However,
some uncertainties have arisen. First, the new Ministry has a clear focus on new information
and communications technologies. Second, many PSREs have been moved from their
traditional Ministry to a new one, whose modus operandi is unknown. Third, the emphasis on
innovation and relationships with firms may threaten the availability of funds for basic
research. All these changes may lead to a shift in the objectives of the research, relationships
with industry and the discourses of many PSREs.

Almost all the Spanish PSREs depend now on the new MCYT1. In addition, each
Autonomous Community designs and implements its own scientific policy. Figure 1 shows an
outline of the main agents of Spanish PSR at the national level in the field of agricultural and

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1 Before the creation of this Ministry the policy-making powers were scattered among ten different
ministries.
agro-food research. The most relevant ones for PITA are CSIC, mainly through the CNB, and INIA. The National Food Centre and National Environmental Health Centre are in charge of toxicological controls and analysis.

**Figure 1 Main agents of Spanish PSR**

Among the Spanish PSREs, there are some with a marked sectoral character and others with a multidisciplinary character that conduct research applicable to several sectors. There were 216 PSREs in 1995; 70 of these were ascribed to the national government and the remaining 146 to the autonomic governments. The largest and most important PSRE is the Higher Council of Scientific Research (CSIC), a multidisciplinary institution that now (since May 2000) depends on the MCYT (previously it depended on the Ministry of Education and Culture). The CSIC accounts for 50% of the financial and human resources of Spain's PSRs and for 6% of all researchers. It produces 18% of all the scientific literature and 25% of the patents held by Spanish PSR (COTEC, 1998).

Regarding agricultural research, PSREs are financed basically by the National R&D Plan (mainly by the Agricultural R&D Sectoral Programme). The National Institute for Agriculture and Food Research and Technology (INIA) is the body responsible for managing the latter programme, which finances the INIA's research centres as well as those ascribed to the Autonomous Communities. In November 1998 the INIA's policy making powers were extended and now cover national actions related to the register of seeds and nursery plants. INIA was the research unit of the Ministry of Agriculture (MAPA) until its transfer to MCYT in 2000. The Fourth National Scientific Research, Development and Technological Innovation Plan (2000-2003) changes the name of the Agriculture R&D Sectoral Programme. Now there are two areas of interest for the PITA project: The Scientific and Technological Area of Agro-Food Resources and Technology and the Sectoral Area of Food. The first includes two strategic actions: the Preservation of genetic resources with an agro-food interest and Farming resources and technologies. The second includes three strategic actions, one of which is relevant to our study: Control of food quality and security. Additionally, there is a Biotechnology Programme with a horizontal character.

In 1997, the area of Life Sciences and Agro-food accounted for 29.6% (6791 million pesetas) of the National Fund for R&D, which is the financial instrument of the National R&D Plan. This area comprises three modalities: Biotechnology, Food Technology and Agricultural R&D. Table 1 shows the breakdown of funding in 1997 between these modalities and types of projects.
Table 1  Funding in 1997 from the National R&D Fund (million Euro)

<table>
<thead>
<tr>
<th>Programmes</th>
<th>Training of research personnel</th>
<th>Compromises previous years</th>
<th>Projects and Special Actions</th>
<th>Integrated projects between research groups and industry</th>
<th>Scientific and Technical Infrastructure</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural R&amp;D</td>
<td>1.9</td>
<td>2.0</td>
<td>2.4</td>
<td>2.5</td>
<td>0.8</td>
<td>0.4</td>
<td>10.0</td>
</tr>
<tr>
<td>Food technology</td>
<td>1.6</td>
<td>1.2</td>
<td>2.8</td>
<td>1.3</td>
<td>0.5</td>
<td>0.4</td>
<td>7.9</td>
</tr>
<tr>
<td>Biotechnology</td>
<td>1.3</td>
<td>1.3</td>
<td>3.3</td>
<td>2.1</td>
<td>1.0</td>
<td>0.3</td>
<td>9.4</td>
</tr>
</tbody>
</table>


We have to add the Environment and Energy National R&D Programme, that includes a number of projects on risks and residues of pesticides in water and soil.

2.2 Main public agricultural research bodies

There are several PSREs that are very important in national agricultural research and innovation that belong to the national or autonomous governments. The CSIC and the INIA are the most important ones at national level. At regional level the most outstanding ones are the IRTA in Catalonia and the IVIA in Valencia. Table 2 shows the main regional PSREs in agricultural research in Spain.

2.2.1 Institute of Agricultural Research of Valencia (IVIA)

The IVIA is a public corporation of the regional government of Valencia under the Regional Department of Agriculture, Fisheries and Food. It was established in 1991 and its objectives are to promote scientific research and technological development in the agro-food sector of the region of Valencia.

Its main tasks are to promote and conduct research projects in the agro-food sector, to transfer the scientific and technological outcomes obtained and to contribute to the training of research staff. Its scientific activities focus on the following research fields: genetic selection and improvement of plant material; plant nutrition and physiology; farming techniques; plant preservation; biotechnology; farming engineering and mechanisation; post-harvesting techniques; farming economy; soils and irrigation; and biometrics. The research focuses mainly on citrus crops, fruits, vine, rice, vegetables and ornamental crops.

2.2.2 Institute of Agro-food Research and Technology of Catalonia (IRTA)

The IRTA is a public corporation of the regional government of Catalonia that focuses on scientific research and technology transfer in the field of agriculture and the agro-food industry.

Table 2  Main regional PSREs in agricultural research in Spain

<table>
<thead>
<tr>
<th>Name</th>
<th>Main research topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institute of Agriculture Researches of Canarias (ICIA)</td>
<td>Tropical and subtropical varieties, plant protection and animal production</td>
</tr>
<tr>
<td>Institute of Agriculture Researches of Valencia (IVIA)</td>
<td>Citrus crops, fruits and rice</td>
</tr>
<tr>
<td>Institute of Agro-food Research and Technology of Catalonia (IRTA)</td>
<td>Horticulture, fruits, extensive crops, plant protection, animal genetics, plant biotechnology, post-harvest,</td>
</tr>
<tr>
<td>Service of Agricultural Research of Extremaduran Regional Government</td>
<td>Extensive crops, vegetables and livestock</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Service of Agricultural Research of the Regional Government of Castile-Leon</td>
<td>Extensive crops and wine</td>
</tr>
<tr>
<td>Fishery and Food Technological Institute of the Basque Country</td>
<td>Fisheries and food</td>
</tr>
<tr>
<td>Galician Centre of Agricultural Research and Technology</td>
<td>Maize, fodder, potato and livestock</td>
</tr>
<tr>
<td>Service of Agro-food Research of Aragonese Regional Government</td>
<td>Agricultural Economy and Sociology, vegetables, fruits and maize</td>
</tr>
<tr>
<td>Centres of Agricultural Research Network of the Andalusian Regional Government (CIFAs)</td>
<td>Extensive crops, olive and vegetables</td>
</tr>
</tbody>
</table>

Its general objectives are to promote research and technological development in the field of agro-food, to facilitate the transfer of technological developments and to assess its own technological developments, aiming at the best possible co-ordination and collaboration between public and private agents. The IRTA conducts its activities by means of Research Centres or Departments and Experimental Stations. The research departments work in 10 areas: horticulture, fruits, extensive crops, plant protection, animal genetics, plant biotechnology, post-harvest, animal feed, meat industries and animal health.

### 2.2.3 Higher Council of Scientific Research (CSIC)

The CSIC is the most important national PSRE. It performs its scientific activity in 111 centres throughout Spain. Of these centres, 29 are run jointly in co-operation with Universities or Autonomous Communities.

The CSIC is an independent body ascribed until May 2000 to the Ministry of Education and Culture. It is a multidisciplinary body, has a national scope, and performs scientific activities ranging from basic research to technological development. Its general objectives are: to draft and implement scientific and technological research projects; to develop training programmes for researchers and technicians; to advise governments on research and innovation issues; and to collaborate with universities and Autonomous Communities in research activities.

CSIC negotiates its ordinary budget through the MCYT. This ordinary budget is included in the General State Budget. CSIC also competes for external funds from public programmes at European, national and regional levels and from contracts with firms or other institutions. Self-financing has become essential to the survival of CSIC; its own resources, coming mainly from contract research with firms and private entities and different public research programmes, accounted for 38% of the total CSIC budget in 1995.

There are four staff categories in the CSIC: permanent staff (civil servants, 52% of total staff in 1995), labour (personnel with contracts of variable type, size and duration, 25%); trainees or fellows (22%) and “associated” or “connected” doctors who may share the resources and rights of the CSIC by means of joint projects and agreements (1%) (Muñoz, Santesmases and Espinosa de los Monteros, 1999).

The research tasks of the CSIC are divided into eight Scientific-Technical Areas: Biology and Biomedicine; Humanities and Social Sciences; Natural Resources; Farming Sciences; Physical Science and Technologies; Science and Technology of Materials; Food Science and Technology; and Chemical Science and Technologies. Figure 2 shows the distribution of funds between these areas in 1996. As we can see in this Chart, Biology and Natural Resources are the main areas.
The **Farming Sciences Area** includes farming, stockbreeding and forestry research projects. The personnel working in this area represent 13% of CSIC’s total personnel, with 263 researchers (CSIC, 1998). This area includes 12 research centres that conduct agricultural research along different lines, including the environmental impact of agrochemicals, the study of weeds, sustainability of farming and forest farming systems, integrated pest and disease control, biotic and non-biotic stress, genetic improvement of herbaceous and fruit crops, the water-soil-plant system and irrigation strategies. It contributes to “intersectoral programmes”, such as "Water", "Improvement of crops with biotic and non-biotic resistance, through classical and molecular genetics", "Pollution from chemical substances", "Improvement of olive tree production" and "Desertification in Mediterranean environments: physical, cultural and socio-economic aspects". Table 3 shows the number of projects and the origin of funds in this area.

The distribution of funds reached through contracts shows that 66% of them come from contracts with national firms and 22% from contracts with Public Administration. By modalities, more than 80% were R&D contracts.

The **Food Science and Technology Area** includes 8 centres and 159 researchers. There are four research lines: technological processes, food preservation and pre-normative research, food biotechnology and nutrition. Table 4 shows the number of projects and the origin of the funds in this area.

Another relevant area is **Biology and Biomedicine**, which conducts basic research on the molecular bases of animal and plant organisms. One of the main centres in this area is the National Biotechnology Centre (CNB), which is in charge of co-ordinating basic research tasks in plant biotechnology within the CSIC. This is state-of-the-art research, not applied research of direct relevance to farmers’ problems. Table 5 shows the number of projects and the origin of the funds in this area.
### Table 3  Resources of Farming Sciences Area, 1994-1996

<table>
<thead>
<tr>
<th>Origin</th>
<th>Modality</th>
<th>Number of projects</th>
<th>Amount (M Euro)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public National Funds</td>
<td>R&amp;D Projects</td>
<td>118</td>
<td>5.4</td>
</tr>
<tr>
<td></td>
<td>Co-financing EU projects</td>
<td>9</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>Special Actions</td>
<td>137</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>Infrastructure</td>
<td>22</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>Technology Transfer Actions (PETRI)</td>
<td>7</td>
<td>0.3</td>
</tr>
<tr>
<td>European Funds</td>
<td></td>
<td>56 (9 as co-ordinators)</td>
<td>7.0</td>
</tr>
<tr>
<td>Contracts^2</td>
<td></td>
<td>99</td>
<td>2.8</td>
</tr>
</tbody>
</table>


1 This is the number of projects in 1996.

2 There are three modalities of contracts: R&D contracts, technical reports and others. These contracts can be signed with Universities and PSREs, Local, Regional or Central Public Administration, public firms, national private firms and foreign firms or organisations.

### Table 4  Resources of Food Science and Technology Area, 1994-96

<table>
<thead>
<tr>
<th>Origin</th>
<th>Modality</th>
<th>Number of projects</th>
<th>Amount (M Euro)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public National Funds</td>
<td>R&amp;D Projects</td>
<td>73</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td>Co-financing EU projects</td>
<td>14</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>Special Actions</td>
<td>56</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>Infrastructures</td>
<td>15</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>Technology Transfer Actions (PETRI)</td>
<td>11</td>
<td>0.5</td>
</tr>
<tr>
<td>European Funds</td>
<td></td>
<td>35 (4 as co-ordinators)</td>
<td>5.6</td>
</tr>
<tr>
<td>Contracts^2</td>
<td></td>
<td>94</td>
<td>3.0</td>
</tr>
</tbody>
</table>


### Table 5  Resources of Biology and Biomedicine Area, 1994-1996

<table>
<thead>
<tr>
<th>Origin</th>
<th>Modality</th>
<th>Number of projects</th>
<th>Amount (M Euro)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public National Funds</td>
<td>R&amp;D Projects</td>
<td>264</td>
<td>24.3</td>
</tr>
<tr>
<td></td>
<td>Co-financing EU projects</td>
<td>29</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>Special Actions</td>
<td>203</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td>Infrastructures</td>
<td>48</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td>Technology Transfer Actions (PETRI)</td>
<td>10</td>
<td>0.4</td>
</tr>
<tr>
<td>European Funds</td>
<td></td>
<td>149 (23 as co-ordinators)</td>
<td>21.0</td>
</tr>
<tr>
<td>Contracts^2</td>
<td></td>
<td>88</td>
<td>8.6</td>
</tr>
</tbody>
</table>

Source: CSIC, 1998
The research activities of the CNB started in 1987. CNB has four main objectives: 1) to develop basic science of high quality, 2) to establish plans for collaboration with industry, 3) to participate in academic activities with the university, 4) to coordinate biotechnology with other centres. These activities are carried out in five departments: molecular and cell biology, microbial biotechnology, plant molecular genetics, macromolecular structure, and immunology and oncology. Together with these groups there are 14 laboratories that support and develop some other aspects of biotechnology (bio-informatics, electron microscopy, spectroscopy and nuclear magnetic resonance, synthesis and analysis of chemical compounds, etc.).

Regarding the first objective (to develop basic science of high quality), recent achievements have been: the discovery and development of agents that control the immune system and cell growth, the role of telomerase in the maintenance of chromosomal integrity and aging, a new oncogen derived from the regulatory subunit of phosphoinositide 3-kinase, novel vaccines with potential against AIDS and malaria, transgenic animals that secrete in milk antibodies that neutralize swine transmissible gastroenteritis virus, animal models for studies of autoimmune, tumor and infectious diseases, a new system for the generation of transgenic animals and for knock-outs, new vectors for gene therapy, microorganisms capable of degrading toxic products and producing novel antibiotics, engineering recombinant pseudomonas to metabolize or to remove through biosorption heavy metals and environmental pollutants, methods for the detection of gluten in food, biosensors for the monitoring of aromatic compounds in contaminated areas, transgenic plants resistant to pathogens and capable of a 20% increase in the production of potato tubers, new procedures for structural analysis, and molecular resolution of oligomeric complexes in solution, and the first method to predict protein-protein interactions from primary sequences.

With regard to relations with industry, CNB maintains regular meetings with the pharmaceutical, agricultural and petrochemical sectors, with the aim of identifying common scientific goals. The CNB has established 12 contracts with national and international companies, to a total value of 6.3 M euro in 1998, up from 5.6 M euro in 1997. Regarding other funds, participation in EU R&D programmes is signifiant (49.9 M euro in 1998). External funding obtained from competitive grants and contracts represents 80% of the total income. One of CNB’s aims is to stimulate the creation of biotechnological start-up companies.

CNB’s total personnel numbered 451 in 1998, of whom 240 were graduate students or postdoctoral associates and 33 were scientific staff (civil servants). It is significant that permanent positions represent only 12% of the total. An international group of experts that form the Scientific Advisory Committee of the CNB evaluate the scientific activities of all the groups every year.

Regarding external relationships, CNB has an “open-house” programme that brings in students from educational centres with the aim to promote their interest in science and to acquaint them with biotechnology. Also, CNB is increasing its participation in the public debate on biotechnology: “We have significantly increased our visibility to society, as several of the research achievements at the CNB received press coverage, and our scientists have participated in radio and television programmes. We believe that providing scientific information to the public is an essential way of promoting society’s interest in biotechnology” (CNB Research Memory, 1997-1998).

2.2.4 National Institute for Agriculture and Food Research and Technology (INIA)

History, function and structure

The National Institute for Agriculture and Food Research and Technology (INIA) was established in 1971 as a result of the merger of the National Institute of Agronomic Research, the Institute of Forestry Research and Experience and the Animal Biology Board. This merger brought together the researchers of the Ministry of Agriculture and Fisheries that worked on agriculture, livestock and forestry. In 1984 the policy powers on agricultural
research were transferred to the Autonomous Communities, which meant that all agricultural research and training centres were now dependent on them, together with most of the scientific potential of the INIA. Notwithstanding, the INIA still keeps an essential role in Spanish agricultural research through its own centres and its coordination task with the research centres of the Autonomous Communities.

We can distinguish four main functions of the INIA:

- to set up the objectives and guidelines of the Spanish agricultural and food research and technological innovation policy and to manage and coordinate the agriculture R&D programmes.
- to carry out research projects and other activities (e.g. laboratory tests) related to the sustainable use of agricultural genetic resources.
- to promote national and international cooperation in the field of agricultural and food research, especially with the Autonomous Communities, through the Farming Research Coordination Commission.
- to implement national policy on seeds and nursery plants regarding the commercial variety and protected variety registers.

The INIA is structured as four units, answering to the Director. Each of them has specific management and organisational tasks. The structural units of the INIA are listed in Figure 3.

![Figure 3 Structure of the INIA](image-url)
The **Secretariat General (SG)** is in charge of budget and human resources management, internal operations, maintenance, preservation, supply management and administrative contracting, legal technical support, documentation, library and editions, as well as all subjects regarding works and product specification.

The **Vice-Directorate General of Prospective and Programme Coordination (SGPCP)** drafts, coordinates, develops and evaluates agro-food research and technology programmes. It is also in charge of implementing prospective studies on technological advances and developments in agriculture and food; the dissemination and use of research results; and the development of the permanent training and recycling programmes for researchers. In the Fourth National R&D Plan INIA, through SGPCP, manages: i) the Sectoral Area of Food and ii) the two strategic actions of the Scientific and Technological Area of Agro-food Resources and Technology: the strategic action Preservation of genetic resources with an agro-food interest and the strategic action of Farming resources and technologies. It also finances part of the research conducted in the farming research centres of the Autonomous Communities.

The SGPCP is divided into four units: the Prospective Unit; the Co-ordination and Management Unit; the International Relations Unit; and the Research Results Transfer Office (OTRI).

The **Vice-Directorate General of Research and Technology (SGIT)** is responsible for managing the research centres that answer to the Institute and for executing the scientific and technical activities connected with the development and application of the agro-food research and technology programmes.

There are four research centres that answer to the SGIT:

- The Central Office of R&D Units (SECE), which includes the following departments: Plant Protection; Genetic Improvement and Biotechnology; Animal Reproduction and Preservation of Zoogenetics Resources; Food Technology; and Sustainable Use of the Natural Environment.
- The Animal Health Research Centre (CISA). The CISA is the Reference Centre of the OIE and the Food and Agricultural Organisation of the UN (FAO) for the African swine pest and the equine pest. It is the European Reference Centre for animal vesicle diseases and the National Reference Centre for exotic diseases.
- The Forestry Research Centre (CIFOR). The work of the CIFOR focuses on forestry and on the characterisation of forestry and non-farming products. It has the following departments: forestry and forest industries, and non-food products.
- Plant Genetic Resources and Sustainable Agriculture Centre (CRF). The CRF participates actively in international forums on plant genetic resources, both multilateral (FAO, CGIAR, EU) and bilateral with 12 non-European countries. It is divided into the following departments: Genetic Preservation Service and Development Service.

The **Spanish Office of Plant Varieties (OEVV)** is the competent body for the registration of plant varieties. There are two registers: Protected Plant Varieties and Commercial Plant Varieties. There is also a laboratory that performs internal analyses to support the activity of the technical units of the OEVV and external analyses to certify the quality and health of seeds and nursery plants at international level.

**Human resources**

In 1997 INIA had a total of 653 employees. Staff numbers vary from year to year according to the number of people undergoing training, which is subject to the normal fluctuations of graduates with scholarships ascribed to centres and universities, and to the changes in numbers of employees (non-civil servants).

More than 45% of the staff of the INIA are civil servants and 23% are long-term employees, while 21% are trainees. Of the total number of employees, 41% work on management tasks and 59% on research activities. The high proportion of employees working on management tasks is due to the wide management activities of INIA (management of the Agricultural and ...
ANNEX E6

Food R&D Sectoral Programme in which all the Autonomous Communities participate, and management of the Spanish Register of Protected Varieties and Commercial Varieties).

**Budget**

Figure 4 shows the two stages that can be identified in the evolution of the budget of the INIA, separated by the transfer of policy powers on research to the Autonomous Communities. Between 1985 and 1992 the budget increased. Since then it has remained fairly stable, at about 30 M Euro.

![Figure 4 INIA's budget, 1982-1997 (M Euro)](image)


**Figure 4 INIA's budget, 1982-1997 (M Euro)**

The largest budget item is the one for staff, which accounted for 43.3% of all budgeted expenses in 1997. The remaining budget items are as follows: real investments (31.3%); current expenditures in good and services (15.3%); capital transfers (7.3%); current transfers (2.7%) and financial assets (0.1%).

Table 6 shows the evolution of INIA’s expenditure on R&D from 1994 to 1998. Commercial income from R&D contracts with industry and other public and private institutions and from analytical services, has been of increasing importance to the funding of INIA’s research activities.

**Table 6 INIA’s expenditure on direct activities of R&D, 1994 to 1998 (million Euro)**

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<td><strong>Commercial Income</strong></td>
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<td>MAPA</td>
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<td>0.4</td>
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<tr>
<td>Other Departments</td>
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<td>0.4</td>
<td>1.0</td>
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<td>0.2</td>
<td>0.2</td>
<td>0.6</td>
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<tr>
<td>Companies and other institutions</td>
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<td>0.2</td>
<td>0.2</td>
<td>0.3</td>
<td>0.5</td>
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<tr>
<td><strong>Total Commercial Income</strong></td>
<td>2.7</td>
<td>1.3</td>
<td>1.8</td>
<td>2.5</td>
<td>3.3</td>
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<tr>
<td><strong>Total</strong></td>
<td>4.4</td>
<td>3.3</td>
<td>3.5</td>
<td>4.3</td>
<td>5.1</td>
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</table>
Research activities

When policy powers on agro-food research were transferred to the Autonomous Communities, the research groups remaining at SGIT were those focused on more basic research with a horizontal activity. This situation is changing and applied research and contracts with the industry and farmers are increasingly important.

The INIA now has 23 patents, some of which are shared with other entities or companies, and 8 applications for patents. It also has the intellectual property rights for 139 plant varieties. It has collaborative agreements with 20 national and international companies and collaborates with local, regional and national governments and other national and international research centres.

The SGIT is in charge of research activities. The most relevant for our work are as follows:

- Biology, ecology and epidemiology studies on pathogenic agents, pests and weeds. Biological, cultural and biotechnological methods for their control.
- Drafting of methods aimed at improving and restricting the use of plant health products. Study of resistance and side effects of plant health products such as herbicide resistance and selectivity.
- Plant material sanitation. Obtaining of plant propagation material and virus-free seeds.
- Study of agriculturally-caused pollution of soils and water. Production of low quality water systems for irrigation. Application of urban and agro-industrial waste for soil amendment.
- Improvement of seed production and plant propagation techniques. Delimitation and characterisation of areas of origin and selection of seeds in forested areas. Preservation and identification techniques for plant genetic resources.
- Studies on water stress and resistance to adverse conditions. Improvement of the current use of water resources in dry and irrigation farming. Studies on the nutrient dynamics and the effectiveness of fertiliser use as well as the tolerance to non-biotic stresses, including low consumption conditions, water stress, cold and salinity.

The most relevant research lines for the PITA project are conducted in the Central Office of R&D Units (SECE) and in the Plant Genetic Resources and Sustainable Agriculture Centre (CRF).

Three departments of the SECE conduct research activities that are relevant for PITA: plant protection, genetic improvement and biotechnology, and sustainable use of the natural environment.

- The **Plant Protection Department** conducts research in entomology (research for the use of biological agents against pests), weed science (study and control of weeds), plant diseases (study of diseases caused by fungi, bacteria or nematodes), plant protection products (PPPs) (production and evaluation of monographic studies of active substances of PPPs in order to include them in the Single European Register, chemical analyses and evaluation of the persistence of PPPs in soils) and plant virology (study of plant diseases induced by viruses, viroids and fitoplasms).
- The **Genetic Improvement and Biotechnology Department** conducts research on genetic improvement and plant biotechnology (development and application of molecular and cytogenetic-molecular techniques, isolation and characterisation of genes involved in physiological processes essential for plant growth, development and application of new diagnosis techniques and general typification of plant viruses).
- The **Sustainable Use of the Natural Environment Department** conducts research on different aspects of sustainable agriculture and the environment (replacement of mineral fertilisers, improvement of flower farming techniques and nutrient balance), aromatic plants (selection, multiplication and farming) and chemistry of PPPs and the environment (sampling methodologies for the evaluation of the environmental behaviour of PPPs).
The CRF is the institution in charge of preserving and improving plant health resources. It consists of two departments: genetic preservation and development.

- The Genetic Preservation Service is in charge of the preservation of genetic resources by means of a basic bank, seed health and rinsing, feasibility control, seed storage and on-field preservation.
- The Development Service is in charge of inventory and documentation, prospecting and recollection, multiplication and regeneration, characterisation and evaluation.

Research priorities and interactions with policies and industry

INIA is very "open" to public policies, as it is a General Directorate of MAPA. INIA is closely related to agricultural regulatory bodies which demand analyses and tests from some of INIA's units. The SGPCP also promotes and co-ordinates research projects to resolve problems originating from changes in regulations (for example, a project to find alternatives to methyl bromide) or to improve research in some strategic sectors, such as oil tree or wine (SGPCP interview, 2000). Sometimes INIA's researchers are called on to participate in policy discussions, at national or European level. However, there is not usually a feedback process from researchers to policy makers and vice versa (SGIT interview, 2000).

Innovation policy is the main influence on R&D priorities because the National R&D Fund is the main source of funding and because INIA implements directly the research policy of the MAPA. MAPA establishes the INIA's R&D priorities through the Agricultural R&D Sectoral Programme (now Sectorial Area of Food). We can sum up the research priorities of the Fourth National Plan in the agricultural area as three lines: new technologies and competitiveness, including biotechnology; food quality and safety, and environment and natural resources management. Food safety and quality issues are gaining importance in the research priorities of INIA, in response to policy makers demands and public concerns.

INIA has participated in the definition of the research priorities of the Fourth National R&D plan through a group formed by the 19 General Directorates of Spanish government with research competencies and through other groups for specific themes. On the basis of National R&D Plan, SGPCP defines a set of strategic research lines. These strategic lines take into account information from meetings with farmers, researchers, industry, etc.. SGPCP carry out prospective analyses, informing the economic sector about trends in research and informing researchers about economic trends (SGPCP interview, 2000).

Research groups at the SGIT have considerable autonomy, defining their own research agenda, although they follow the MAPA general guidelines established in the Agricultural R&D Sectoral Programme because this is one of their main sources of funding. They also compete with other institutions for funding from such sources as the National R&D Plan, EU programmes, and contracts with industry. In future, contracts with industry will be increasingly important because the National R&D Plan and RTD Framework Programme V favour collaboration with private companies (SGIT interview, 2000).

Changes in environmental policies have triggered or reinforced research into "clean solutions" to the environmental problems of agriculture. Environmental issues have increasing importance among research priorities, mainly because of policy pressures concerning the reduction of the environmental impacts of agriculture, but also because of the need to preserve the quality of natural resources for agriculture and for rural development (SGIT interview, 2000). There is an area of Sustainable Use of the Natural Environment within the SECE of SGIT that is focused on this issues, but other groups in other areas (such as plant protection and biotechnology) work on environmental problems too. However, research linked to the solution of environmental problems still forms only a small proportion of INIA's research projects.

Agricultural policies are also important, as INIA has depended until now on funding from the MAPA. Reforms of the CAP and the common market, stimulating further the modernisation of farming systems, have prompted MAPA and INIA to set up special research projects. Examples include the Strategic Action "Improvement of the quality and competitiveness of wine" and the Programme "Improvement of the production quality of the
oil tree in Spain", especially designed to coordinate and increase the efforts of Spanish research on innovation throughout the production chain, from the genetic improvement of varieties to the transformation process.

**Industry** does not have a direct influence on the definition of research priorities, as few firms invest in long-term R&D projects with INIA or other PSREs as partners. Most of the joint research projects have a medium duration of three or four years and their objective is to resolve immediate problems. Innovation policy is trying to re-orient public research to meet the demands of industry and society, increasing the amount of money available for joint research projects. So, researchers have been stimulated to find firms interested in their activities, and contracts with firms are an increasingly important source of income, but there is no sign yet of an integrated agricultural system of innovation involving PSREs and firms in an innovation network.

The still marginal role of firms in the definition of research priorities and the strict division of functions between SGPCP and SGIT avoids the potential conflict between INIA’s roles as a provider of basic research and participant in technological programmes (SGIT) and as supporters of regulatory bodies (SGPCP).

### 3. Roles played by PSREs

From a policy maker’s perspective, PSREs play five different roles:

1. **Providing the basic research for the applied research activities of industrial enterprises.**

   In the biotechnology area, this role is played basically by CNB, since this was one of the main reasons of its foundation. In other areas (seeds, agrochemicals), CSIC and INIA sometimes play this role, although it is not the main focus of their research, and their relationships with industrial enterprises more often have a technical focus.

2. **Transmitting their technical knowledge to (local) companies by participating in technological programmes.**

   This role is being promoted by Spanish R&D policy and by the National R&D Plan, mainly through PETRI actions (Programme for the Stimulation of the Transfer of Research Results). Technological collaborations have increased in the last few years. Direct contracts with private companies have also increased significantly. In the case of INIA, income from contracts with companies has risen from 5% of total commercial income in 1994 to 17% in 1998. This role has been played mostly by INIA through SGIT, although CSIC has also played this role in the last few years as an extra source of funding.

3. **Developing the competencies of researchers to enable them to set up companies of their own and to provide a local pool of skilled labour for industry.**

   Job mobility from the PSREs to the private sector is uncommon. This role is played by CNB. Providing a local pool of skilled labour, CNB has an "open-house" programme to promote students’ interest in biotechnological research and to receive researchers from other centres for a fixed time. On the other hand, one of the motivations of CNB is to stimulate the creation of biotechnological start-up companies.

4. **Supporting the controls performed by regulatory bodies, for example by conducting laboratory analyses.**

   This role is played by INIA through the Spanish Office of Vegetal Varieties for seed and IPR regulations and through SGIT for pesticides and other agricultural resources regulations. Also the CSIC play this role, for example, the Ministry of Environment has funded a research project with the CSIC to assess the ecological risks of Bt maize and to prevent the appearance of resistant insects.
5. Acting as a critical watchdog on behalf of the public.

Traditionally, public sector researchers have had a high degree of credibility among Spanish society. CSIC and universities, in particular, are prestigious institutions. In many cases they have advised government and public and private institutions, giving their independent opinion and assessment. However, in the case of biotechnology, Spanish PSREs do not fulfil the role of critical watchdog. Most relevant researchers who participate in the public debate in the mass media defend biotechnology and reply to the “radical” discourses from environmental NGOs. They see the problem of public fear as a lack of knowledge, so some of them have published informative books on biotechnology.

4. Conclusions

PSREs play a very important role in the Spanish agricultural system of innovation, as providers of basic and applied research and support for the regulatory process. Their contribution to the agricultural system of innovation in terms of expenditure, personnel, number of research projects and results is higher than that of private firms. In Spain there is a fair number of PSREs and universities engaged in agricultural research at regional level, funded by the Autonomous Communities. At national level the most important ones are CSIC and INIA. Both are engaged in basic and applied research in the fields of seeds, agrochemicals and biotechnology, and their main resources come from public funds.

Within the CSIC, the CNB is devoted to basic science of high quality in biotechnology and to plans for collaboration with industry. It also co-ordinates biotechnology research with other centres. The CNB has a clear focus on industry needs and important agreements with national and foreign companies. Its role includes the promotion of “start up” biotechnology companies.

The INIA has two main roles: as manager of agricultural programmes in the National R&D Plan and as executor of research projects. As a research organisation, INIA is focused on agro-food research, with a basic and applied character, and on the provision of services to farmers and other public and private institutions.

Regarding the influences on their research priorities, innovation policy has a more important impact on PSRE activities than other policies for two main reasons. First, it is their main source of funding. Secondly, as mentioned above, the PSREs seem to function independently from other systems, in particular the economic and productive systems. The Fourth National R&D Plan has been designed to change this situation and is re-orienting public sector research towards the needs of economic sectors and society. Contracts and collaborations with industry have increased in recent years, although private companies still play only a minor role in the definition of research priorities. In the case of INIA’s priorities, agricultural policy and farmers needs are important influences, as INIA is the research body of the MAPA and has a long tradition of providing advice and services to the agricultural sector.

Regarding interactions with regulatory bodies, both CSIC and INIA assist in the control, monitoring and assessment processes. Since neither organisation has a long tradition of supplying private institutions with knowledge and technologies, the question of a conflict with their role as providers of independent expertise has not arisen.

Environmental concern is now a key element of the R&D Spanish policy “discourse”. This can be seen in the case of agro-food research policy, as the new Agro-food Resources and Technology Area of the Fourth National R&D Plan has been established with the purpose of “meeting social demands and needs to develop sustainable production, preservation and transformation of agro-food and fishing products within an integrated rural development approach” (CICYT, 1999). Both CSIC and INIA have research lines for the solution of environmental problems and improved efficiency of the management of natural resources in agriculture. The CSIC, in particular, has on many occasions assessed environmental impacts and risks. In general, although environmental issues are gaining importance in the definition
of research objectives, there has not been a great increase in the resources devoted to this area.

Biotechnology is considered a key technology for the future of agriculture because it improves on traditional breeding techniques, broadens the understanding of living organisms and accelerates the resolution of environmental and agriculture problems, especially because GMO varieties could reduce the need for agrochemicals in agriculture. Biotechnology is defended by Spanish researchers and the current debate on biotechnology is seen as a problem of misinformation that will be resolved as the technology evolves.
Sources

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Internet sites

- Web page of the MAPA: [www.mapya.es](http://www.mapya.es)
- Web page of the CSIC: [www.csic.es](http://www.csic.es)
- Web page of the INIA: [www.inia.es](http://www.inia.es)
- Web page of the IRTA: [www.irta.es](http://www.irta.es)
- Web page of the IVIA: [www.ivia.es](http://www.ivia.es)
- Web page of the CNB: [www.cnb.uam.es](http://www.cnb.uam.es)

INIA interviews

Rafael Ponz Ascaso, General Vice-Director of Prospective and Programme Coordination, Madrid, 25-02-00

Cristina Gallego, International Relations Unit, Madrid, 25/02/00

José Luis Milas Climent, Manager of International Scientific Relations Unit, Madrid, 25/02/00

Alejandro López de Roma, General Vice-Director of Research and Technology, Madrid 10/03/00

Javier Martínez Vassallo, Technical Adviser for Scientific Management, Madrid, 10/03/00

Martín Fernández de Gorostiza, Director of Spanish Office of Vegetal Varieties, Madrid, 5/04/00
### Abbreviations

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<tr>
<th>Abbreviation</th>
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<tr>
<td>CICYT</td>
<td>Inter-ministry Commission of Science and Technology</td>
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<td>Higher Council of Scientific Research</td>
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