The Cartagena Protocol on Biosafety

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Revamping agricultural research policies in industrialized countries

Funding for agricultural research grew rapidly from the 1950s until the late 1970s, generating substantial growth in agricultural productivity. Since then, the rate of growth in public spending in many developed economies has subsided. At the same time, institutional changes have been implemented and incentives for private research and public-private partnerships have been strengthened. These changes have implications for agricultural research and its funding.

Changes in institutional aspects of agricultural research policies since the late 1970s include: new funding mechanisms, reorganization and privatization of research institutions, introduction of managed competition, broadening of the research agenda, strengthening of intellectual property rights, and adjustments in research orientation.

This article explores the implications of these institutional changes in five countries that together represent more than 40 per cent of total public investments in agricultural research by countries of the Organisation for Economic Co-operation and Development (OECD) in the mid-1990s: Australia, the Netherlands, New Zealand, the United Kingdom, and the United States. Figure 1 (see box on page 21) provides trends in public R&D investments among the OECD countries; Table 1 gives corresponding figures for private agricultural R&D (see box on page 20).

Public agricultural R&D institutions

Over the past 20 years, the public agencies implementing agricultural research in the Netherlands, New Zealand and the United Kingdom have been substantially revamped. In England, Wales and in the Netherlands, the agencies that perform public research and development (R&D) were consolidated, and in some cases, commercialized. In New Zealand, the government established Crown Research Institutes (CRIs) in an effort to develop a public market for R&D services. Comparatively little structural change took place in the public agencies conducting agricultural R&D in Australia, although the government made substantial changes in funding and management structures. Less comprehensive shifts occurred in the United States, perhaps because of the relative independence of individual states in funding and executing public agricultural research. The timing of reforms in each of these five countries was closely linked to the advent of governments with more market-oriented economic philosophies.

Levy funds

The five countries each placed increased emphasis on the role of the private sector (especially industry and commodity groups) in financing and managing public agricultural research. Australia provides one of the most dramatic examples. Legislation in 1985 and 1989 created Research and Development Corporations (RDCs) to manage research funds generated by commodity levies matched dollar-for-dollar by the government to a limit of 0.5 per cent of the gross value of industry production. Funding through the RDCs now accounts for about one third of the total publicly performed agricultural R&D in Australia.

Changes in Australian legislation also increased industry representation on the RDC boards and project selection committees. The introduction of Cooperative Research Centres (CRCs) in the 1990s, linking research by government, universities and the private sector, was meant to foster joint public-private ventures and revitalize growth in total funding. However, the transaction costs associated with establishing and managing interagency consortiums may be an important limitation.

In the Netherlands, as in Australia, the principle of joint dollar-for-dollar, public-private funding for experiment stations and other agricultural research programmes remains a key element of agricultural research policy. During the late 1970s and 1980s, the Netherlands' Ministry of Agriculture was confronted by successive budget crises and re-emphasized the importance of joint public-private funding. For instance, the Wageningen Agricultural University was encouraged to seek funding from industry sources for research projects. As a result, private funding, which represented less than 25 per cent of total university funds for agricultural research in the 1970s, accounted for more than 40 per cent by the mid-1990s.

In New Zealand, statutory bodies have used levies to support market development and research programmes since the 1920s. In 1990, the New Zealand government passed the Commodity Levies Act under which industry groups were given authority to impose mandatory levies to fund sector-specific research and market development activities. As a result, new commodity group funds were established for several agricultural products.

In the United Kingdom, in conjunction with the decision to reduce funding for applied research, the Thatcher government passed legislation in the mid-1980s enabling the creation of commodity-specific statutory bodies. These institutions, to be funded by industry levies, aimed to develop markets and fund commodity-specific applied research. Industry representatives increasingly dominated their boards of directors. Statutory bodies have now been established for all major agricultural commodities, although they account for only about six per cent of total public expenditures on agricultural research.

The United States makes little use of levy-based support for agricultural R&D, perhaps because the government does not provide matching government funds. Private-sector funding for public agricultural research has
generally increased since 1975, largely as a result of increased private funding for State Agricultural Experiment Station (SAES) operations. There is no evidence of any pressure to expand the use of commodity levy programmes to fund agricultural R&D. In 1995, only 7 per cent of SAES funding came from industry sources, and only a fraction of that came from levies. This implies that there is room for expanding the use of this type of funding mechanism in the United States.

**Privatization**

Privatization of agricultural research can be accomplished either directly or indirectly. The United Kingdom directly privatized some agricultural research institutes in the late 1980s and early 1990s. This move followed the government's economy-wide programme to privatize many publicly owned enterprises and to stop funding and managing 'near-market' applied research. In New Zealand, the government opted to carry out all of its agricultural research through a comprehensive system of quasi-private, public research organizations called CRIs. In the Netherlands, in the mid-1980s the government determined that many agricultural research programmes could be placed in the hands of the private sector. Since then, agricultural research institutes previously funded and managed by the Ministry of Agriculture have been increasingly detached from its control and have become more reliant on private funding sources. Thus, all five countries have indirectly privatized some research by opening up access to public funds to private and independent research agencies, and three countries have taken (or are in the process of taking) more direct action.

**Managed competition**

Since the mid-1980s, many countries have begun to shift away from lump-sum grants or formula-based allocation procedures and towards competitive allocation mechanisms. In Australia, the Netherlands, New Zealand, the United Kingdom and the United States the proportion of funds disbursed through lump-sum or formula funds has fallen, while the proportion of funds disbursed through competitive or quasi-competitive grant processes has grown.

Although much has been said about the move toward competition, and away from formula funding, actual progress in that direction has been uneven. New Zealand has moved fastest and farthest, but some observers have questioned the effectiveness of the new institutional arrangements and whether the costs of increased rent-seeking activities (such as lobbying efforts by industry, scientists, and others to influence the allocation of resources) outweigh the benefits of competition. The United States has minimally moved in this direction. In 1995, only US$ 101 million, as part of a public agricultural R&D budget of US$ 3.0 billion, was allocated through competitive grants. The other countries lie between these extremes, both in their stated intentions and in their actions.

**Basic and applied research**

Markets for agricultural R&D are said to fail when private incentives provided by market mechanisms lead to a different amount and a different mix of research than would be socially optimal. For R&D this most often arises in cases where the 'public good' nature of the resulting knowledge may pose an obstacle to rendering the research benefits fully privately appropriable. This results in underinvestment in research from society's perspective because the firms developing a technology may be unable to capture or appropriate all of the benefits accruing to the innovation. Underinvestment tends to be more pronounced for more basic (and less applied) forms of research, providing a case for public funding of such R&D. Since the benefits from applied R&D tend to be more appropriable, the economic rationale for public funding for this type of research is less compelling. Obtaining an effective mix of basic and applied research is a challenging public policy problem.

A recent trend in the Netherlands, the United Kingdom, and the United States has been the apparent redirection of research funds derived from general tax revenues toward basic research and away from applied research. All three countries report similar patterns of change. For

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**Private agricultural R&D expenditure**

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<tr>
<td></td>
<td>(millions 1985 US dollars)</td>
<td>(millions 1985 US dollars)</td>
<td>(per cent per year)</td>
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<tr>
<td>Australia</td>
<td>25.2</td>
<td>137.3</td>
<td>151</td>
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<tr>
<td>Netherlands</td>
<td>183.7</td>
<td>281.3</td>
<td>3.7</td>
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<tr>
<td>New Zealand</td>
<td>9.9</td>
<td>40.0</td>
<td>13.8</td>
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<tr>
<td>United Kingdom</td>
<td>414.6</td>
<td>614.8</td>
<td>4.8</td>
</tr>
<tr>
<td>United States</td>
<td>1,417.9</td>
<td>2,391.5</td>
<td>4.3</td>
</tr>
<tr>
<td>Other OECD</td>
<td>1,963.9</td>
<td>3,543.9</td>
<td>5.4</td>
</tr>
<tr>
<td>OECD total</td>
<td>4,015.2</td>
<td>7,008.8</td>
<td>5.0</td>
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instance, the share of public agricultural R&D funds allocated to universities that typically engage in more basic types of research has increased, at least through to the mid-1990s, for which comparative data are available. The evidence on Australia and New Zealand is less clear. In Australia, RDCs and CRCs have probably directed more funds toward applied research. In New Zealand, the creation of the Public Good Science Fund in 1992 was intended to reallocate public R&D resources to more general public good and public-interest research. However, it is not clear that public resources have been substantially redirected toward more basic agricultural research.

**Broadening research agendas**

Another common thread in the evolution of agricultural policy processes in developed economies has been the increased influence of non-farm interest groups on agricultural policy. Since the mid-1970s, the United Kingdom and the Netherlands have both allocated substantial resources to their Ministries of Agriculture for research on environmental and conservation issues. In the United States, the environmental lobby, with the support of scientists, has greatly influenced the agricultural research agenda, leading to large publicly funded R&D programmes devoted to issues such as sustainable agriculture and the maintenance of wetlands. Similar developments have occurred in Australia.

A less-widely recognized phenomenon has been the increased influence of agribusiness and consumer lobbies on agricultural R&D. Since the mid-1980s in the United Kingdom, representatives of the food processing industry have been given more influence on agricultural research oversight committees, which have subsequently recommended reallocations of public research resources to address issues of concern to that sector. A similar development has taken place in Australia, partly through the changed structure of the RDC boards and the development of CRCs with significant agribusiness involvement. In New Zealand, agribusiness representatives have also been given a larger role in determining the allocation of public agricultural research funds, and public funding for food-processing research increased markedly in the mid-1990s.

**What to make of these changes?**

Any assessment of these changes in public agricultural R&D policies must take account of their effects on economic efficiency (that is, the productivity consequences of research) and socioeconomic welfare (that is the amount and distribution of the net social benefits from R&D). On these grounds, questions can be raised about reductions in the growth rates for public agricultural R&D funding, since empirical evidence shows relatively high rates of return from those investments. Most studies have reported annual rates of return well in excess of 30 per cent per annum.

The increasing role of the private sector in the management of public agricultural R&D has potential costs and benefits. Industry-dominated research boards may redirect public funds to projects that benefit only sectoral interests, or part of an industry, or that provide payoffs in the shorter rather than longer run. In addition, the expansion of public-private ventures may discourage private investment in R&D by allowing firms to substitute government funding for their own resources. On the other hand, increased input from industry may balance the influence of scientists and government bureaucrats who have their own academic and bureaucratic objectives, or who may lack information on research opportunities.

In principle, increasing competition for research funds can provide funding organizations with helpful information about research opportunities. Competitive processes can reduce the costs of information and of research resource misallocation, but may also involve additional costs. The challenge is to devise institutions that minimize all costs of research decisions, including the less visible but significant costs of resource misallocation, as well as the more obvious costs of competing for funds. These include the resources used for preparing and evaluating grant proposals as well as for lobbying granting agencies. Evaluation processes could incorporate past research performance and pre-screen project ideas as a basis for reviewing full proposals, and make award decisions on the basis of expected research outcomes rather than on the basis of research processes (such as earmarking resources for less focused ‘multidisciplinary’ research).

Broadening the research agenda may also lead to benefits. Environmental and food safety issues involve what economists call public goods, and markets often fail to efficiently provide these goods. Accordingly, a reallocation of public research resources to these issues and away from ‘near-market’ research programmes may enhance economic welfare. Whether these reallocations will produce substantial social benefits is unclear, however, because little reliable evidence is available.

The diversion of public resources toward agribusiness and food processing research (as in the United Kingdom and New Zealand, and possibly in Australia) also may
Push and Pull: Biological control of stemborer and Striga

In issue No. 41, the Biotechnology and Development Monitor published an article by Verkleij & Kuiper about various approaches to controlling Striga (witchweed) and Orobanche (broomrape). The root parasites are a major biotic constraint to food production particularly in Africa. The authors showed that conventional methods of controlling these weeds have only a limited impact and that transgenic plants do not offer a workable solution either. Now the International Centre for Insect Physiology and Ecology (ICIPE) in Kenya has developed a push-pull system against stemborer in maize that also controls Striga.

Cereal stemborers, the larval stage of certain moths (Busseola fusca, Sesamia calpistis, Eldana saccharina, Chilo archacollicilus and Chilo partellus), can cause the loss of about 20 to 40 per cent of the potential yield of a maize or sorghum crop. They are difficult to control because the eggs and the larvae are hidden deep inside the stems. In a push-pull system different plants are sown with the crop. The pests are repelled from the field by one plant and, at the same time, attracted by others planted outside the field. In this way they do not feed on the actual crop plant itself.

In the combined cropping system developed by the ICIPE for South and East Africa, the stemborer is attracted to napier grass (Pennisetum purpureum) or Sudan grass (Sorghum vulgare sudanense) by their smell. The grass is grown in several rows outside the maize field and produces a gummy substance that traps the larvae's. In the ICIPE pilot project only about 10 per cent of the stemborer larvae's eventually survived. The project started with the knowledge that stemborers were indigenous to East Africa long before maize was introduced and that the insect must have feed on another type of grass in the past. Farmers in the neighbourhood of the ICIPE research station were invited to choose which grass they thought might be most suitable. They preferred napier and Sudan grass because both make good fodder. Varieties of wild grass that looked like 'weeds' were rejected.

From the inside of the field, the stemborer is repelled by molasses grass (Melinis minutiflora) or by silver leaf desmodium (Desmodium uncinatum). In tests, the use of molasses grass reduced the maize crop losses from 40 per cent to 4.6 per cent. Desmodium seems to be even better equipped for inter-cropping. As a leguminose it binds nitrogen and thus enriches the soil. It also keeps the soil moist, reduces erosion and can be used as fodder. But most important, desmodium intercropped with maize suppresses the growth of Striga by a factor of 40 in comparison to monocropping of maize. The scientific reason for this is unknown but ICIPE has set up a research project, funded by the Rockefeller Foundation (USA) to investigate the phenomena.

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