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Competitive Funds for Agricultural Research: Are They Achieving What We Want?

INTRODUCTION

Sustainable rural and agricultural development are essential in any strategy to reduce urban and rural poverty, increase food security and promote general economic growth while preserving the productive environment. Several factors are shaping the evolution of agriculture and development strategies towards a more knowledge-based approach. These include the persistence of poverty, the need for better understanding of the agriculture–environmental nexus, and the increase in global trade and changes in food demands. Conditioning this evolution are changes in science and technology, a revolution in information and communication technologies and major institutional changes including new roles for the public sector and civil society.

Agricultural technology generated by public and private investments in agricultural research in the more developed countries, in the international agricultural research centres and in the national agricultural research systems of less developed countries has contributed to the extraordinary success in worldwide agricultural production. However, agricultural innovation systems must now respond not only to the factors affecting productivity but also to growing demands for relevant, long-term, public-good research addressing other goals. Such research has traditionally fallen to the public sector both to fund and execute. It includes work in applied crop management, yield improvement of basic food crops, natural resource management, conservation of biodiversity and research achieved at alleviating poverty in areas of low potential.

As a result of profound economic and fiscal reforms, worldwide funding for public agricultural research grew at a slower rate in the 1990s than it did in the 1970s and 1980s, and in some countries it has even decreased. Its composition is changing: unrestricted budgetary support to public research institutions is declining while an increasingly large portion of public support is taking on new forms such a project-based or contract research. As a result, competition among institutions for available public funds has grown. This has led to increased efforts of research organizations to find alternative sources of research

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funds and of funding agencies to find new mechanisms to allocate these funds effectively.

In recent years, public research organizations have been faced by greater demands on their research capacity, but at the same time they are confronted by a vicious circle of increasingly tight budgets and lower research performance. That is, with fewer resources, research organizations may become less effective and efficient and, in turn, attract less funding. In Latin America, where the decline in funding first became apparent, new approaches for funding and organizing research (such as joint public/private-sector ventures, commercialization of research results, competitive schemes and farmer-managed levies on agricultural production) have developed over the past two decades. There is a growing feeling that the traditional public block grant funding to centralized suppliers of technology should be used more efficiently. As a consequence, future national research systems may exhibit considerable diversity in both funding sources and institutional plurality in conducting research (Echeverría *et al.,* 1996).

In addition to the factors internal to the research system that contribute to the decline in support, two overarching structural elements help explain the stagnation of public sector funding for agricultural research: (a) the perceived new, reduced role of the state, which increasingly uses market mechanisms (such as financing) instead of getting involved in producing goods and providing services, and (b) the movement of the agricultural sector itself towards a commercial agribusiness sector linked to global markets. The first factor has led to budget cuts, recommendations for more demand-driven mechanisms for allocating research funds, increased use of contracts, and pressure on public research organizations to obtain a larger share of funds by competitive means. The modernization of agriculture, liberalized markets and trade regimes, as well as strengthened intellectual property rights have created expectations that private companies will become increasingly active in developing countries, mainly through the sale of agricultural inputs and marketing of commodities. Trade liberalization has also promoted the transfer of technology embodied in inputs, decreasing the need for local research in some cases.

There is evidence that private sector agricultural production and research activities are increasing in developing countries (Pray and Umali, 1998). However, private sector activities are concentrated primarily in a few large economies (Brazil, India, China) and they are developing more slowly than in the more industrialized countries. Significantly, the increased participation of the private sector in agricultural research in most cases complements rather than substitutes for public sector activities. This may explain its concentration in countries with already strong research systems. This paper distinguishes between the roles of the public and private sectors in financing and executing agricultural research.[1] While the private sector may expand its role in *developing* agricultural technology, the public sector is still the main source of *funding* for agricultural research in developing countries.

However, the more traditional form of direct appropriations for research institutes is changing, and other instruments for funding research are being created. This paper focuses on one such mechanism: *competitive grant pro-*

grammes (CGPs). It assumes that the trend to allocate research resources competitively will continue and that research organizations will have to acquire a greater share of their funding through competition in the foreseeable future. Therefore a discussion of the preconditions for successful CGPs and of the criteria to evaluate their performance is timely.

Policy makers and donors may see CGPs as an effective tool to redirect priorities, increase accountability to funding sources and strengthen the participation of universities, foundations and other non-public research organizations in national research activities. Research managers, in turn, may see competitive grants as an additional source of resources – particularly of scarce operating funds – and as a device to develop joint ventures with other public and private sector research organizations. The growing attention given to CGPs (in particular by multilateral and bilateral development agencies) has focused mainly on the development of such schemes. Less importance has been given to the circumstances under which the use of CGPs can be most appropriate, the complementarity of CGPs to other funding instruments, and their sustainability. However, because they are 'in fashion', CGPs are at risk of being recommended as the panacea for several funding and institutional problems of national systems, diverting attention from the more crucial topics of lack of research resources and of national priorities to use them effectively.

In the United States and Australia, the trend towards CGPs has been a matter of concern to many authors. Huffman and Just (1994) argue that the growing proportion of public funds to agricultural R&D allocated competitively in the USA lowers economic efficiency because CGPs have high transaction costs. Similarly, Tisdell (1995, 1996), drawing on Australian experience, has pointed out how competitive bidding for research funds can lead to economic inefficiencies by involving short-term processes 'of a relatively destructive nature', and that competitive grants need to be supplemented by mechanisms for funding new researchers and institutions. In both cases, it has been argued that traditional institutional grants not only preserve the short-term stability of funding, but also allow for reallocation of funds in the longer term.

This paper examines the characteristics of successful CGPs in the overall context of financing agricultural research. Competitive funding is just one of several instruments to generate and allocate research funds; as such, institutional and competitive funding should not be viewed as substitutes but rather as complements. The question (still before us) concerns the appropriate mix of competitive and institutional funding for optimal research performance (Ruttan, 1982). To answer we need to look at, among other things, the full range of funding mechanisms, depending on the type of research, its purpose and the structure of distribution of research benefits (spillovers) in each particular case (Schweikhardt and Bonnen, 1997).

A PLURALITY OF FUNDING MECHANISMS

Traditional block grant funding is giving way to new mechanisms through which research is becoming more pluralistic in its financing and execution. In

developing countries, several public and private sector organizations conduct research. They include public sector research institutes, agricultural universities, commodity institutes linked with producers' associations, foundations and public–private corporations, non-governmental organizations and private entities (plantations, input companies and the agribusiness and food sector). Many of them are directly linked to particular sources of funding not open to others. In addition, international research centres play a key role by conducting strategic research with wide distribution of benefits across countries.

During the past two decades, the somewhat reduced role of the state in the economies of many developing countries and a need for greater fiscal austerity have called into question the role of the public sector in supporting agricultural development in general, and agricultural research in particular. Despite the renewed interest in the private sector and a relative decline in the role of governments, there are areas of research that must be paid for (and probably also conducted) by the public sector. Otherwise, because of market failure, it is likely that crucial research activities will not be carried out. This so-called 'public good' research area is dynamic and, in many cases, shrinking as new products and processes (where intellectual property rights can be appropriated) are being developed by the private sector.

Because of such multiple and complementary roles for public and private sector funding of research, all the components of a national system may be active to varying degrees in any given country. Nevertheless, agricultural research in developing countries remains largely in the public sector, while most private sector effort is concentrated in the food industry, plantation crops, mechanical farm implements and chemicals, pharmaceuticals and seeds. And most of this research is not done by local companies alone, but also by multinationals on a worldwide basis.[2]

National agricultural research in developing countries relies on direct support from public sources (national and international), own resource mobilization and revenues from commercial operations. *Direct-block grants* and *earmarked transfers* have been the traditional public sector funding mechanisms to national research institutes and public universities, respectively. Increasingly, public funds are being channelled through contracts and competitive mechanisms.

In spite of this shift, CGPs still remain a small portion of the total. In the USA, competitive grants under the National Research Initiative accounted for about 12 per cent of the total research portfolio in 1999. In a recent submission, the National Science Council, the Committee for the National Institute for the Environment, recommended that the competitive share rise to 35 per cent. The Agricultural Research Council of South Africa, while struggling to take on the new challenges of emerging farmers while generating revenue from commercial farmers, argued that core funding from public sources (parliamentary grant) should not drop below 50 per cent. In New Zealand, block core funding of the Crown Research Institutes is now approximately 10 per cent; the rest is all competitive funding (Dunbier, 2000).

Mobilizing own resources is a second, increasingly important, source of funding for research organizations. *Grants from donors, income from endow-*

ments, charges for services and *check-offs* are used by research foundations and farmers' associations to fund their own programmes, or to contract other public and/or private sector providers. This is the case with grants to research foundations and levies on output to fund commodity institutes or other organizations by specific contracts. For instance, the Foundation for Agricultural Development of Ecuador (FUNDAGRO) was established as an endowment in 1986 to cover agricultural research, education and extension. With a strong preponderance of donor (that is, public) money behind it, FUNDAGRO was subjected to many of the same implicit constraints as the national institute had been (Sarles, 1990).

Retained earnings are, in turn, the most common source of research funding by the private sector, such as agricultural input companies or agribusiness and food sector organizations. Tax concessions are proving effective in increasing investment in research. Other significant sources for the public sector are joint-venture contracts as well as proceeds from user charges. Projects supported by research foundations are also becoming significant within the private sector.

Funding mechanisms vary widely across countries and within countries over time. For instance, in Latin America in the early 1990s, direct government transfers ranged from approximately 80 per cent in Brazil and Mexico to 40 per cent in Chile, where 26 per cent of funding came from sales of products and services (Cremers and Roseboom, 1997).[3] Financing in the more developed countries has also changed. In the Netherlands, where the public sector pays for 40 to 50 per cent of research, most work is now done through supplier contracts. The principal supplier is a recently created organization formed by merging the Agricultural Research Department of the Ministry of Agriculture and Fisheries and Wageningen Agricultural University. Roseboom and Rutten (1998) identify three trends in selected developed countries: an increase in public funds that match farmer levies through rural industry corporations (Australia); a switch from input to output financing and increasing reliance on private funding (the Netherlands and New Zealand); and a decrease in institutional funding with an increase in CGPs (USA).

Table 1 illustrates the relative effectiveness of alternative funding mechanisms as they relate to different programme objectives. The table reminds us that a portfolio of mechanisms is needed to ensure that the multiple objectives are addressed. The weights shown are subjective, but plausibly represent the usefulness of each mechanism in addressing the stated objective.

Competitive grants are often proposed as a way of introducing new priorities. However, their appropriateness relative to other funding mechanisms in a balanced portfolio of goals and mechanisms should be examined. It is often argued that a CGP pursuing scientific excellence or seeking to push yield ceilings upwards will favour wealthier regions and institutions while formula funding and special allocations better ensure that local equity concerns are taken care of. Where government contracts substitute for direct block grants as sources of funds, they may still have a positive effect on institutional development if allocated to new areas or used for training and research assistance. Conversely, they may divert resources to ad hoc projects and draw down both human and institutional capital. Certainly, every mechanism can be managed

TABLE 1 *Funding mechanisms and objectives*

Objective	Formula funding	Competitive grant programme	Special allocations	Government contracts	Private sector funding
Productivity	++	++	+	+	+++
Scientific innovation	++	+++	+	+	++
Scientific quality	++	+++	+	++	++
Client-driven research	+	++	+++	+++	+++
Equity by region or target group	++	+	+++	++	—
Institutional development	+++	+	++	+	+
Institutional collaboration	+	+++	+	++	+
Sustainability	+++	++	+	++	++

better: competitive grants may become more client-oriented by allocating resources to mission-oriented rather than fundamental research and special allocations may improve their quality by introducing both scientific peer review and 'merit review' procedures.

As mentioned earlier, CGPs funded from public sources are increasingly common in developing countries. The size of the competitive share in total research funding should be related to the capacity of the research system. Competitive funds are good for mobilizing and focusing existing resources. If the main priority is to develop research capacity rather than mobilize it, institutional block funding will be preferable to competitive grants. Clearly, the issue is one of the appropriate mix of competitive and institutional funding for optimal research performance or attainment of non-research goals.

ATTRIBUTES OF SUCCESSFUL COMPETITIVE GRANT PROGRAMMES

A recent review of the USDA 'National Research Initiative Competitive Grants Programme' (Board on Agriculture, 2000) highlights four key attributes of a successful CGP: (a) *quality* (the research is novel, valuable, feasible and technically sound); (b) *fairness* (proposals are evaluated seriously by a well-qualified group of reviewers with strict adherence to a set of criteria relating to quality and relevance); (c) *relevance* (the research will effectively meet national needs); and (d) *flexibility* (capacity to shift in response to emerging fields of research and to support the intrinsic flexibility in the research enterprise itself).[4]

TABLE 2 *A typology of competitive grants systems*

Type	Nature and objectives	Governance and *funding*	Example
National			
Multisectoral	Development of science, academic research, including unspecified themes based on scientific merit and contracts for specific research topics	Science & technology council *National budget*	CONICYT: Venezuela FONDECYT: Chile
	Strengthening research links between universities and other organizations	Science & technology council *Public grants*	FONDEF: Chile
	General technology development, open to all sectors of the economy	Development corporation *Loans, donor grants*	FONTEC: Chile
Agricultural sector	Agricultural technology development	Ministry of agriculture *USDA-USA*	FIA: Chile, NARF: Tanzania
	Applied research, transfer and training, small producers	Ministry of Agriculture *World Bank loan, Government*	PRONATTA: Columbia
	Agricultural technology development	National Institute–Research Council *World Bank Loan, grants*	PRODETAB Brazil, ARF: Kenya
	Specific commodity research, funded by Producers and public sector budget	Agricultural Development Corporation *Government/industry*	GRDC: Australia

Regional			
Multisectoral	Regional strategic agricultural technology development, funds from member countries	Scientific council *Multi-year plan*	INCO-DEV (European Union)
Agricultural Sector	Regional technology programmes, funds from member countries invested in endowment	Board of directors *Endowment fund administered by IDB*	Latin American Regional Fund for Agric. Research (FONTAGRO)
	Regional transfer of technology for small-holders	Steering committee *USAID funds*	East/Central Africa Fund (ASARECA)
International			
Foundations	Strategic socioeconomic development research	Non-profit foundation *Endowment*	Ford, Rockefeller
Development Research	Strategic economic development research	International council *Annual parliamentary grant*	IDRC: Canada
Agricultural research methodology	Support to ecoregional activities	Scientific Advisory Committee *Multi-year depleting fund*	Ecoregional Fund Dutch-Swiss grants (ISNAR administered)

Competitive schemes can be classified according to three characteristics: (a) their national, regional, or international reach, (b) their stated objectives and governance and (c) whether they are from endowed trusts or one-time depleting funds. The nature of support to research may be influenced by whether or not the funds are from annual grants or from stable investment income. Table 2 provides examples of CGP schemes with objectives that span the range from broad human welfare to specific methodology development. Before establishing a CGP scheme, it is essential to assess the merits of using such a mechanism for the objective to be pursued and the type of research to promote. Important structural considerations are the size of the system (the 'research market'), the scope of research eligible for submission to the competition, the creation of a sound and credible governance mechanism, and the potential sustainability of the system.

By widening the eligibility for grants, CGPs can also mobilize capacity in agricultural universities and research foundations, as well as provide opportunities to strengthen links among national and international research organizations. CGPs can generate a wider set of research ideas, among which the most promising could be actually funded. In this situation, CGP schemes may solve an information problem, focusing the competition on research topics (output) and not necessarily on research institutions (input). This may be of particular importance in more basic research areas, where funding agencies depend more on their interaction with scientists to develop a research portfolio. At the more applied end of the research spectrum, a CGP scheme may have a better defined set of research outputs to fund and the mechanism can be used in order to find the lowest-cost provider.

One of the major *disadvantages* of current CGPs (see Table 3) is lack of funding for human and physical capital. In order to be able to conduct research (and compete for grants), organizations must have a minimum budget to cover the costs of a critical mass of staff and for the maintenance and upgrading of physical and human resources. Given the nature of agricultural sciences, both elements depreciate quite rapidly. Moreover, a medium-term agenda requires continuity of funding over several years (for example, animal and plant breeding, natural resource management) and CGPs with a short-run bias may not be advantageous. Unless longer-term projects are funded, more basic research may be neglected in favour of short-term applied research.

Before launching CGPs, there is a need to analyse the *costs* of establishing and operating such mechanisms. Overhead costs of administration of a national CGP can be substantial if one fully costs activities such as (a) identifying priorities, (b) developing procedures (manuals of operation), (c) evaluating proposals, and (d) contracting and monitoring project execution. In addition, there are significant costs associated with preparing project proposals, panel and peer reviews for screening proposals, meetings of boards of directors, and publishing calls for proposals, results, annual reports and medium-term plans.

In spite of the fact that CGPs could provide better accountability, they are not immune to lack of transparency in the identification of priorities, conservatism in the allocation of resources and inflexibility in the use of funds. Managers of CGPs could bias priorities towards less productive research activities and, if

TABLE 3 *Potential advantages and disadvantages of having competitive grants programmes*

Advantages	Disadvantages
Increases research *effectiveness* by directing resources to the most productive scientists, by merit (improves costs quality and accountability of research)	*Limited nature of funding* (funds only operation costs; lack of support to core budget salaries and maintenance of research facilities)
Increases research *efficiency* by reducing direct costs via competition and cofinancing schemes, duplication of efforts, lack of accountability of research resources, underutilization of infrastructure by providing operating resources	*Short-term funding*, lack of support for medium- to long-term research agenda
Promotes the identification of and consensus on national research *priorities*	*Low institutionalization*, lack of support to human capital development and to new research infrastructure
Increases *flexibility* to focus on newly emerging national/regional priority issues	Higher funding *uncertainty* could affect long-term projects and reduce confidence of research staff
Promotes a *goal-oriented* and demand-driven national research system	*High transaction costs* from grant seeking, proposal writing and implementation reports; less time for research
Strengthens *vertical links* between research and extension organizations, agricultural production and agricultural policies	*Reduces research flexibility* to focus on additional (not open for competition) issues when researchers discover new research opportunities
Strengthens *horizontal links* among national, regional and international public and private research organizations; promotes 'spill-ins'	*Higher risks* involved when research consortia involve less well-known organizations
More *diversification of funding* by involving scientists from outside traditional organizations; promotes 'system'	*Low sustainability* of funding when national constituency is weak and external funding sources dry up (unless it is an endowment)
Induces *institutional change* in the national innovation system, separating research policy, funding and implementation	Needs a *minimum market size*, a research system with a minimum number of competitors (larger countries probable best suited)
May mobilize *additional funding*	Legal, financial, administrative and technical *costs of setting up and administrating*
Merit review process provides expert feedback to researchers' proposals and objectivity of the competitive process, *improving research quality*	May be *biased to strong research organizations*, increasing 'equity issue' due to lack of competitive capacity of poorer/smaller organizations
	Possibility of '*rent seeking*' in the process of allocating resources to research

funding priorities are too rigid, a scientist's initiative to pursue promising new research activities can be hampered. In this sense, CGPs could become less client-driven than traditional institutional funding, and they could quickly redirect scarce funds to research priorities defined by technology funds managers. In addition, Huffman and Just (1995) examine the possibility that, given the high transaction costs of CGPs in the USA, they could increase rent-seeking activities by scientists relative to block grants or formula allocations. That could reduce both the real funding available to research and the productivity of research resource use.

KEY ELEMENTS FOR ESTABLISHING COMPETITIVE GRANTS

Given the particular national conditions facing agriculture and science and technology, each country would need a somewhat different competitive system. The following issues are minimum requirements (not rigorous recommendations) to be considered when establishing CGPs.

Research capacity

In a competitive research market, a substantial number of competitors are needed for CGPs to work. That is, a minimum research capacity and a level playing field are required for competition to operate, assuring a wide supply of high-quality competing research proposals. Research capacity relates to the relative number of scientists in any given discipline and the pool of potential reviewers of proposals, which in smaller systems may be limited. Moreover, if interinstitutional collaboration is required by the grant, the alliance may include all potential competitors. Therefore CGPs are more appropriate for the larger national agricultural research systems than for the smaller ones with few research organizations and a small number of scientists in relevant disciplines.[5] National research capacity could be expanded by open competition to providers from outside the country, and/or by setting up regional competitive funds.

Focus

A competitive fund should focus on a subset of the total priorities of the science and technology system best pursued by this mechanism. It need not take on all political objectives of the national system where other objectives are best pursued by other instruments. The identified priorities should be technically sound, feasible and attainable in the short-to-medium term. A limited number of priorities (which can gradually increase over time) will assure the consolidation of a CGP. Research priorities on a competitive programme should be defined in a participatory manner in order to build national consensus on strategic goals. Moreover, CGPs can be an effective instrument to promote research collaboration in new priority research areas that require multidisciplinary efforts. Maintaining a medium-term research focus will also help to avoid politically based allocations. Short-lived CGP schemes are less

appropriate when the real need is to strengthen research infrastructure and when the desired results require research of a long-term nature.[6]

Governance

A CGP may be best located in an independent institution which does not itself bid for grants. The governing body should be high-profile and pluralistic, and set priorities in line with national priorities. A transparent management system is critical. It should be explained how priorities are identified, and how proposals are evaluated. Priorities and procedures should be publicized well in advance and not subject to unexpected annual changes. The call for proposals needs to be precise, must be public and widely distributed, accessible to all potential applicants and given sufficient time for quality proposals to be prepared. Clear statements on size of grant, nature of activities funded and specific conditions need to be published. Also, establishing an efficient system of awarding contracts could minimize conflicts of interest.

The expected value of a grant

The average size of award and the probability of success in achieving funding must be such that top-quality scientists are encouraged to submit proposals. From the scientist's point of view, the expected return on the costs of preparing a serious proposal must be adequate and the integrity of the review process must reduce the risk and uncertainty involved. From the society's point of view, transaction costs of the programme must be realistic both in terms of administration and review costs and in the costs of preparing proposals.

Quality of review

The process must be transparent, professional, anonymous and subject to external evaluation. A sound evaluation system based on merit should include at least the following criteria: technical quality, institutional capacity, expected socioeconomic impact (including efficiency and equity considerations) and environmental impact.

Sustainability

All the key elements discussed before influence the financial and institutional sustainability of CGPs. Because the costs of setting up and consolidating them high, and their impact in redirecting priorities and allocating resources can also be strong, it is essential that the life expectancy of a CGP be long, and that it becomes a stable mechanism for funding. Unless this stability is accomplished, depleting funds are usually at risk of non-replenishment.[7] Above all, the impact of agricultural research funded via CGPs will assure its sustainability; hence the importance of defining criteria to measure such performance.

CRITERIA FOR MEASURING PERFORMANCE

The performance of agricultural research is defined by its effectiveness in meeting goals and efficiency of execution. Relevance and quality of research affect effectiveness, while resource costs and management of research affect efficiency. Two other key factors influence performance: sustainability of relevant funding and the institutional setting in which research takes place. Table 4 identifies four criteria for measuring the performance of a CGP: increased effectiveness, increased efficiency, the promotion of favourable institutional change and observance of accepted public finance criteria.

Although all criteria are related (additional resources and institutional change may have a positive effect on research efficiency and effectiveness, and vice versa), performance must be judged first and foremost by its impact on the goals of the programme. This is why clear goals are essential at the outset. Where those are scientific, we need to look for indicators of research effectiveness (impact on factor productivity, rate of return to research, adoption of results, poverty) and research efficiency. The task becomes complex when there are multiple goals that are different in nature, for example, scientific, economic, political or institutional. It then becomes necessary to define indicators for the political and institutional objectives and some way of weighting these objectives against the efficiency and effectiveness objectives. Finally, the CGP can be judged in the same way we would judge any other public finance mechanism, that is by its revenue implications (additionality), allocative efficiency (distortion of expenditure) and administrative burden (costs of collection and disbursement).

ASSESSING THE PERFORMANCE OF AGRICULTURAL RESEARCH COMPETITIVE FUNDS IN CHILE

For more than two decades Chile has been a laboratory for successful market and institutional reforms. Chile is one of the few developing country cases where several national competitive grants systems for agricultural research have been in place for more than a decade. Examples of multisectoral CGPs are FONDECYT and FONDEF, both at the National Science and Technology Council level (CONYCIT), as well as two specific agricultural technology funds (FIA and PTT from INDAP) (Echeverría *et al.*, 1996).

As shown in Table 5, Chile demonstrates a generally positive trend in both total and agricultural R&D investment over the period 1979–97. Universities account for approximately half of the national research expenditure throughout the period, while the share of competitive funds has increased from less than 1 per cent at the end of the 1970s to about 25 per cent of the total national research expenditure by the end of the 1990s.

Public funds allocated competitively to agricultural research in Chile have increased significantly during the past 10 years: from less than US$2 million in 1988 to almost US$60 million in 1998 (MEFR, 1998). Block grants to the national research institute, INIA, increased over the same period from about

TABLE 4 *Criteria and indicators for measuring performance of competitive grants*

Criterion	Indicator (benchmark)
Increased effectiveness (impact of research results attributed to research projects financed by competitive grants)	Factor productivity (crop yields, labour productivity) Trend in natural resource degradation (soil erosion rates) Social rate of return to research (percentage) Rate of adoption of research results (shape of adoption curve) Absolute and relative poverty rates (percentage) Scientific quality and spillover benefits (publications, citations, peer evaluation)
Increased efficiency (costs of doing research attributed to research projects financed by competitive grants)	Outsourcing: share of contracted research within project activities (% of total) Delivery: number of projects completed within a year after the planned date Success rate: number of projects that have achieved the planned results Punctuality: ratio of realized and planned time for project execution (%) Length of project cycle (number of months)
Promotion of favourable institutional change	Partnerships: national, regional and international research joint ventures in a given year (number) Importance: trend of national research budget allocated to CGPs and to direct institutional funding (% over time) Confidence: share of private sector funding in total research expenditure (%) and number of joint ventures Ownership: stakeholder participation in governance, priority setting and planning events (numbers, share in total, level of responsibility) Institutional capacity: staff qualification index, annual turnover rate
Public finance	Additionality of resources attracted by CGP: from clients, government, private sector, partners (annual growth rate of national agricultural research budget) Allocative efficiency of resources and impact on research priorities in relation to national goals (change in resource allocation to new goals) Administrative costs of collection and disbursement of funds (relative to total grant activity) Transaction costs and preparation costs for applicants, reviewers, panel

TABLE 5 *Chile: National and agriculture R&D expenditures (1979–97)*

Year	Total national (US$m)	Universities (%)	Comp. funds (%)	Agriculture (% of total)
1979	82.56	44.3	0.47	
1980	107.59	45.3	1.12	
1981	123.86	52.9	2.29	
1982	108.91	57.1	3.32	
1983	96.21	54.5	1.48	
1984	99.63	51.2	4.82	7.28
1985	80.43	50.3	7.12	12.32
1986	81.19	50.6	9.16	15.53
1987	105.80	46.0	8.35	11.92
1988	109.33	49.1	12.75	13.72
1989	129.73	57.8	15.14	14.54
1990	154.93	54.7	13.37	19.84
1991	183.56	55.0	13.56	22.69
1992	248.90	26.3	22.63	19.49
1993	287.20	46.3	25.02	24.33
1994	338.59	48.9	22.16	27.24
1995	422.25	48.5	20.98	25.10
1996	461.77	46.1	23.89	26.08
1997	497.51	47.1	24.90	17.16

Source: CONICYT, *Indicadores Científicos y Tecnológicos*. An agriculture share is not available prior to 1984.

US$27 million to US$46 million. The Agricultural Investment Fund of the Ministry of Agriculture, with a current annual budget close to US$6 million, funds research projects of private companies (40 per cent), universities (30 per cent) and public institutes (30 per cent).

The National S&T Fund (FONDECYT) is the largest and oldest CGP in the country. It also provides the largest absolute amount of funding for agricultural research, although a significantly decreasing trend brought its support to agriculture to less than 5 per cent of its investment in 1998. FONDEF, on the contrary, has had an increasing trend in agricultural research investments since its creation in 1993, now reaching levels close to 50 per cent of its total. It is now the second most important CGP for agriculture in the country, followed by FONTEC, which is open to all sectors and is managed by a development corporation (CORFO) and FIA, managed by the Ministry of Agriculture.

Figure 1 shows the relative importance of each funding source, and the fact that CGPs have, in general, added resources to those of the national public research institute. INIA had the largest agricultural research budget in Chile, followed by the INDAP expenditure in transfer of technology. A large share (40 per cent) of INIA's budget still comes from government block grants.

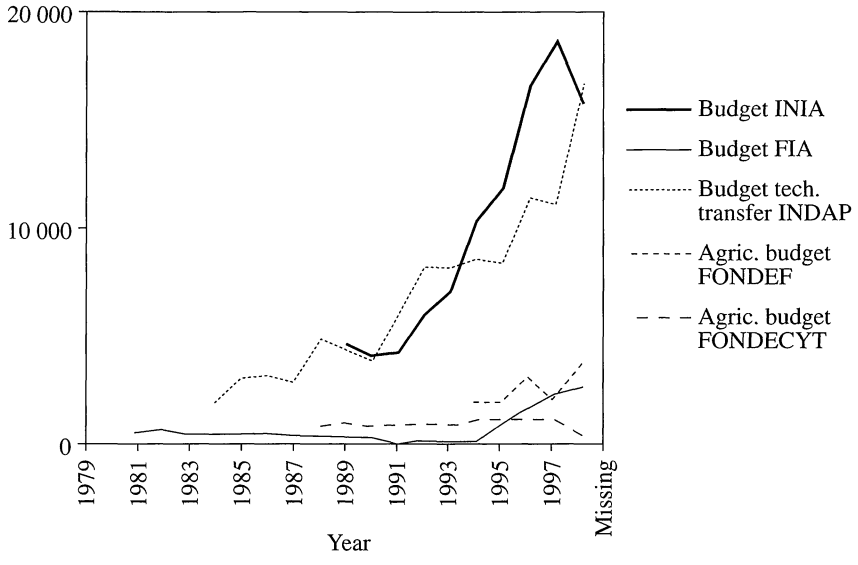

FIGURE 1 *Chile: National Agriculture Research Institute (INIA) and competitive agriculture funds investment trends (in constant 1997 Chilean pesos)*

Competitive funds from FONDEF, FONDECYT and FIA accounted for less than 2 per cent of the institute budget during the 1990s.

According to a recent study of CGPs in Chile by Escobar and Berdegué for ODI (reported in Gill and Carney, 1999), most funds related to agriculture have not promoted their stated objectives of participation, decentralization, networking and feedback to proponents of research projects. On the other hand, the CGPs have had an agile administration and transparency of operations.

When assessing the performance of competitive grants, we need to be precise about whose performance is being looked at. Is it (a) the impact of research on national goals partially funded by the CGP, (b) the increased allocative efficiency in research gained through the competitive grant mechanism, or (c) the efficiency and effectiveness of the competitive grant scheme as a fiscal mechanism? We need to set up and collect information relating to each of these.

Indicators must have a number of characteristics. They must be relevant, independent, precise and realistic, and verifiable at reasonable cost (TAC, 1998). To be relevant, the indicator must capture the essential achievement of the project from the point of view of the target group or funding agency. To be independent, the indicator must logically be at the same level as the corresponding objective, neither the cause nor the effect of achieving the objective. To be precise and realistic, the indicator might specify the target group, quantity and quality of the target achieved, the time frame and the location where

TABLE 6 *Chile: Criteria for assessing performance of competitive funds*

Criteria	Level of impact	Comments on indicators
Effectiveness		
Factor productivity	Macro	Yield data (at field level) on five commodities benefiting from investment in research
	Project	Data not disaggregated by commodity and source of funding
Trend in natural resource degradation	Macro	Data not available
Social rate of return to research	Project	Not included in analysis
Rate of adoption of research results	Project	An indicator of potential gains in factor productivity at field level coming from research (i.e. lower level than productivity indicator)
Absolute and relative poverty rates	Macro	Aggregate national poverty and rural poverty data an indicator of higher-order goals
	Project	If project addresses poverty directly, could be direct indicator
Increased efficiency of research		
Outsourcing: share of contracted research within project activities	Project	Intended indicator that research is being outsourced to most efficient supplier of services
Delivery: number of projects completed within 1 year of planned date	Project	Direct indicator of efficiency of design, selection and execution of projects. Data potentially available
	CGP	Aggregate data of percentage of such projects could be indicator of programme effectiveness
Success: number of projects that have achieved planned results	CGP	Indicator of effectiveness of the selection process
Efficiency of execution: ratio of actual to planned time required to complete project	Project	Direct indicator of efficiency of design, selection and execution of projects. Data potentially available
	CGP	Aggregate data of percentage of such projects could be indicator of programme effectiveness

Length of project cycle (months)	CGP	Indicator of efficiency of management of CGP
Transactions costs of CGP as percentage of grants	CGP	Ratio of successful applications to total submissions. Indicator of efficiency of management of CGP
	Project	Preparation costs in relation to funding received
Institutional change		
Partnerships: national, regional, international joint ventures	Project	Indicator of change in mode of doing research at both the project and institutional levels; more pluralistic system
Importance of CGPs: trend in share of national research budget passing through CGP mechanisms	Macro	Indicator may have a double interpretation: in systems where total funding is rising it may indicate confidence; in shrinking systems it may indicate a lack of confidence and withdrawal of commitment
Public finance		
Additionality: new resources attracted by CGP	Project Research system	Earmarked resources for new priorities and well-defined projects may attract funding
Allocative efficiency: improved resource allocation to new goals and priorities	Project Research system	Allocation of competitive funds clearly different from allocation of traditional budget in the way that new priorities are effectively addressed
Administrative costs of collection and disbursement of funds	CGP	Effective check-off and earmarking system in place and record of expenditures
	Research system	Number of funds serving identified clients Common funding in place
Transaction costs: preparation costs for applicants, cost of reviewers and panels	CGP	Administrative, travel, honoraria, meeting costs
	Research system	Social costs of unsuccessful proposals

TABLE 7 *Chile: characteristics of the performance indicators utilized for each criterion*

Criteria and Indicators	Level of Impact	Relevant and Substantial	Independent	Verifiable	Target	Precise and Realistic			
						Quality	Quantity	Time	Location
Effectiveness									
Factor productivity	Macro, Project	Yield 5 crops	Yes	Yes	National	Yes	Yes	Yes	National
Trend in natural resource degradation	Macro	None	Yes	Yes, high cost	Subregion	Possible	Possible	Periodic	Subregion
Social rate of return to research	Project	Commodity rate of return	Yes	Case study	Crop programme	Costly cases	Case by case	Periodic	National, subregion
Rate of adoption of research results	Project	Technology or commodity	Prerequisite for impact	Case study	Single case	Costly cases	Case by case	One-off	Recommendation domain
Absolute and relative poverty rates	Macro or Project			Poverty survey	National or target group	Aggregate or project-related	National survey Case study	Annual or periodic	National Cases
Increased efficiency of research									
Outsourcing: share of contracted research within project activities	Project	Proxy for low-cost provider	Leads to efficiency, does not measure it	Yes	Project	Project document specifies	Project document specifies	Project-related	n.a.
Delivery: number of projects completed within 1 year of planned date	CGP	Measures achievement in design and execution	Yes	Yes	Project, CGP	CGP records	CGP records	Project related	
Success: number of projects that have achieved planned results	CGP	Measures achievement in design and execution	Yes	Yes	Project CGP	CGP records	CGP records		

Punctuality: ratio of actual to planned time required to complete project	CGP	Measures achievement in design and execution	Yes	Yes	Project, CGP	CGP records	CGP records		
Length of project cycle (months)	CGP	Measures efficiency of CGP itself	Measures CGP efficiency, proxy for research efficiency	Yes	CGP	CGP records	CGP records		
Transactions costs of CGP as percentage of grants	CGP, Project	Measures efficiency of CGP itself	Measures CGP efficiency, proxy for research efficiency	Yes	CGP, Donors	CGP records	CGP records		
Institutional change									
Partnerships: national, regional, international joint ventures	Project, Research system	A goal or a means to an efficiency goal	proxy for efficient research, independent goal	Yes	Research institutes	Data on organizations	n.a.	Periodic	National
Importance: trend in share of national research budget passing through CGP	Macro	A presumed means to efficient allocation	Lower-level indicator	yes	Research system donors	Funding data	Reports from CG Funds	Annual reports	National
Client confidence: share of private sector funding in joint total research and number of joint ventures	Macro, Project	Proxy for complementarity	Measures extent of collaboration	Yes					

TABLE 7 *concluded*

Criteria and Indicators	Level of Impact	Relevant and Substantial	Independent	Verifiable	Precise and Realistic				
					Target	Quality	Quantity	Time	Location
Ownership: stakeholder participation in governance, priority setting and planning	Project, Research system	Participation a means to efficiency and effectiveness	May be an objective as well as a means	Yes	Project and Institute	Reports of planning meetings	Continuous	Continuous	Institute, programme
Institutional capacity: staff qualification index, turnover	Institute, Project	Resource quality and stability	Prerequisite for efficiency and effective research	Yes	Institute or programme	Staffing statistics	Available	On record	Institute or programme
Public finance									
Additionality: new resources attracted by CGP	System, Project	Direct measure of new support	Yes	Yes	CGP, Project, System	Good	Available	Annual	CGP
Allocative efficiency: improved resource allocation to new goals and priorities	Project Research system	Identify increased flows to new priorities	Yes	Yes	Programme	Good	Good	Annual	CGP National
Administrative costs of collection and disbursement	CGP, System	Identify full cost of programme	Yes	Yes	CGP	CGP records	Good	Annual	CGP
Transactions costs: preparation costs for applicants, cost of reviewers and panels	CGP, System	Identify full cost	Yes, measure of input	CGP records	CGP, Donors	Good	Good	Annual	National CGP

the objective is realized. To be verifiable, we need to specify the information, source and responsibility for and frequency of collection of it.[8]

We draw on available information to assess the performance of the competitive grant system in Chile. We speak of a 'system' because research is funded from a wide range of science and technology funds, development funds and institutions using their own block grants. The varied nature of funding in Chile provides a good case study that brings out the complementarity between institutional block funding and competitive grant funds and their interaction as part of an overall system for funding agricultural research.

In Table 6 we look at the criteria for assessing the performance of CGPs, indicate the level (project, institutional, research system) at which the performance is measured and provide some initial evidence of the impact using secondary data from Chile that were collected for other purposes. The main lesson is that performance indicators need to be built into the programmes from the start for monitoring purposes. In Table 7, we specified the characteristics of the indicators for each given criterion.

CONCLUSIONS

This concluding section summarizes the foregoing discussions by making a number of points about CGPs that seem to be corroborated by the Chilean material.

- The competitive grant mechanism is capable of improving resource allocation within research but is not a solution for the problem created by general decreases in resources invested in research. Competitive grants may improve the productivity of existing research staff and infrastructure through provision of operating funds. In this respect they have a qualitative impact on research output that may be disproportionate to their share in total funding. They may represent an improvement in the mechanism by which research resources are allocated to national priorities. In the case of Chile, the philosophy of the market has created so many competing funds that there is danger of fragmentation of the system. Fortunately, institutional support has increased at the same time, so that an integrated programme can be maintained.
- If, by improving the image of research, they can lead to a resurgence of support to research of all kinds they contribute to the sustainability of research. The shift to competitive funding may provide increased accountability to funding sources and lead to sustained institutional support.
- Competitive funds need an institutional base on which to build. For a competitive grant system to work there must be competitors. The system must be sufficiently large and diverse for a market in research services to exist. Furthermore, there is a need to maintain a critical research capacity (infrastructure and human capital) through public institutional funding.

- CGPs are not designed for institution building, although provisions can be built into them that help sustain research capacity. First, they may systematically provide funds for training of junior researchers and incentives for established researchers to remain in the system. Second, they may bring new actors into the research market through requiring interinstitutional collaboration and providing for outsourcing of services. In the case of Chile, universities have taken up a large share of resources.
- CGPs are not especially well designed to support long-term research but procedures for development uptake and technology transfer can be built into the scheme if the CGP itself has a long-term life and sufficient vision.
- There is a need to identify the balance between institutional and project support that is optimal for the goals that are sought. Funding mechanisms are often linked to particular interests and specialized in the way they can be tapped and used. A portfolio approach to funding is needed. Strong institutional support exists in most of the advanced and market-oriented systems and, even there, the role of special non-competitive grants to less favoured regions and institutions is accepted. In the case of Chile, the constancy of institutional support has gone hand-in-hand with growing funding from competitive sources.
- Competitive grants for basic research can bring out the most innovative ideas; for applied research they can bring out the most efficient service provider.
- Competitive grant programmes become part of the science and technology policy of the country. They must be designed to fit into the policy and governance structures of the country in which they are located. This may entail concern with broader science and technology issues rather than agricultural research alone. The philosophy and politics of a country will have an influence on the operation of competitive funds, just as they have on traditional forms of support to research, unless the goals of the fund are very specific and the procedures for allocation to those goals very transparent.
- It is necessary to establish and defend the integrity of the goals of the fund. They must be clearly set out and high standards must be maintained from the start of operations. For this, indicators of performance must be set up at the time of creation of the fund. A system of direct and indirect indicators must provide fund managers with the information needed to take timely action to correct divergences from research goals, programme strategy and fund efficiency.
- In the case of Chile, of the four criteria for measuring the performance of CGPs, increased efficiency and public finance seem to have had a much larger effect than increased effectiveness and the promotion of institutional change.

NOTES

[1]The paper draws on an overview paper by Elliott and Echeverría (2000) presented at a conference on competitive funding organized by EMBRAPA in Brazil; a series of case studies on competitive funds in India, Chile, Colombia, Kenya, Tanzania, Mali and Senegal conducted by the Overseas Development Institute (ODI) of the UK (Gill and Carney, 1999); World Bank guidelines documenting the steps in the process of setting up and operating a CGP and lessons and challenges of competitive funding of agricultural research (George, 2000; Byerlee, 2000); and an ISNAR discussion paper on competitive funding (Echeverría, 1998). The interpretations and conclusions of the paper are those of the authors and should not be attributed to any agency mentioned in the paper. The collaboration of Germán Escobar and Julio Berdegué (RIMISP) with data from Chile is greatly appreciated.

[2]In Latin America in the mid-1990s, public sector research represented close to 70 per cent of the total agricultural research expenditure, while the shares of universities, private companies and farmers' funding averaged about 10 per cent each, with wide variation across countries (Echeverría, 1998b). By comparison, the private sector share of agricultural R&D in the USA and the UK was close to 60 per cent, with shares between 15 and 35 per cent for public institutes and 25 and 5 per cent for universities (Pray and Umali, 1998). See Alston *et al.* (1998) for worldwide trends in public investments in agricultural research and private sector research expenditure in OECD countries.

[3]The Brazilian cocoa research institute (CEPLAC) provides an example of funding variation over time: stable for over three decades, farmers' financing from a levy on production stopped after commodity prices plummeted and a serious disease affected production.

[4]See Echeverría (1998b) for a full description and examples of use of national, regional and international funds.

[5]Competition is effectively limited in countries with only one relatively large research organization (only one provider in the market). In fact, a competitive system may lead to decreased competition and increased inequality because of the lack of the capacity of smaller institutions to compete. This has occurred in countries where research institutions in relatively poor states compete with stronger institutions in the wealthy states and 'scientific quality' is the sole criterion for evaluating proposals.

[6]On the other hand, outside developing-country agriculture, CGPs are quite common within the long-term research establishment. Whether or not CGPs have a long time horizon and promote more basic research depends more on the mandate of the funding agency and sustainability of its funding than on the competitive mechanism as such.

[7]Endowments, on the other hand, have the advantage of financial sustainability. There are intermediate models between perpetual endowments and depleting funds, where for instance a combination of the investment income and the fund itself is used to support research activities over a specified period of time, say 10 to 15 years ('sinking fund').

[8]Where possible, we look for direct indicators that can be a precise and operational restatement of the objective. Such indicators are easier to formulate at the output level. Indirect or proxy indicators may be used where the objective is not directly observable (or the cost of collecting indicators is too high or the indicator only becomes verifiable after the end of the project).

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