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# Economic Issues for Plant Breeding - Public Funding and Private Ownership

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## Abstract

The world of plant breeding is changing rapidly in response both to scientific developments and to economic forces. In particular, there is a growing trend to widespread privatisation of crop breeding. An economist's perspective on some of the key differences between traditional public plant breeding and private plant breeding will be presented together with some of the key driving forces behind the emerging trend to privatisation of plant breeding.

A possible consequence of much greater private involvement in Australian plant breeding is the crowding-out of all other competition by a very small number of large multi-national firms, who might then exploit their market power to capture almost all of the value created by plant breeding. Australian grain growers have already demonstrate a willingness to fund local plant breeding firms to forestall such a threat, and to ensure ongoing access to locally bred varieties that maintain Australia's competitive advantage in international grain markets.

Another threat is the risk that government and grower support of pre-breeding research will decline without any compensating investment by the private sector. As this type of research provides the foundation for ongoing long-term variety improvement and productivity gains, eventually private investment in plant breeding may stall as a result. Alternatively there may be wasteful duplication and/or inefficient utilisation of such related R&D as firms strive for competitive advantage in the market place.

In any event, the access regime for both public and private plant breeders to output from all government and/or collective industry funded research and other generic services will be an important policy issue. Some of the principles under-pinning National Competition Policy will be reviewed as a possible basis for the formulation of an appropriate policy.

## Introduction

Economic outcomes in the "plant breeding industry" are being driven by interactions between advances in scientific knowledge, changes in the legal framework for intellectual property rights, and competitive forces in the market. While extended property rights have created the foundation for new markets, the opportunities arising from scientific discoveries have provided powerful incentives for firms to enter these markets and invest in plant breeding. The competitive forces unleashed by these developments are likely to transform the production of new plant varieties.

This potential for modern plant breeding to create value in the supply chain is one of the driving forces behind the increasing privatisation of plant breeding. In conjunction with an enhanced ability for plant breeding organisations to appropriate a sizeable share of the benefits from improved varieties; it is inevitable that crop breeding in Australia faces a transition from a system dominated by public plant breeding programs to one in which private plant breeding plays a much more important role. Moreover, even if public and/or grower funded plant breeding programs survive for some crops, they also will be under pressure to operate more commercially and at least recover the costs of the

breeding program (as distinct from costs of seed multiplication) by charging growers more for newly released varieties.

As a result, there will be increasing commercialization of breeding programs, and much more widespread application of intellectual property rights to both germplasm and to breeding technologies. These changes are discussed in more detail below, including the underlying reasons and the policy issues that need to be addressed to ensure that the potential benefits to society are realised.

## The Trend to Privatisation

Historically most plant breeding in Australia was conducted by "public" research organisations that were financed mainly from government revenue (Jarrett, 1990). The supporting research in agronomy, plant pathology, entomology, biometry, plant nutrition, plant physiology, and other cognate disciplines also was publicly financed. Improved varieties were freely released to producers at nominal costs that at best only partially recovered the costs of breeding, let alone making any contribution to funding the cost of supporting research.

While there has been a gradual substitution of collective industry derived funding for government funding for several decades, until recently plant breeding has continued to be conducted mainly in state government Departments of Agriculture, with selected universities and CSIRO also playing a role in some areas.

There are now clear indications of a growing trend in Australia to privatisation of plant breeding for many crops. Many public systems are rapidly being overshadowed by private alternatives in which both new enabling technologies and improved cultivars are routinely protected by intellectual property rights.

In this paper, the term privatised plant breeding is used to include any plant breeding program that is conducted on a "for profit" basis, or even on a "full cost recovery" basis. It includes plant breeding by profit making firms as well as other organisations that seek to finance the plant breeding operations by selling seed, or otherwise appropriating some of the benefits generated from growing improved varieties. Such appropriation methods include charging seed royalties, technology use fees, "end point royalties", and "Closed Loop Marketing Agreements" (CLMA).

Public plant breeding includes most other types of program, including publicly funded plant breeding conducted by universities or government agencies, or even contracted out to private institutions. It also includes plant breeding programs funded collectively by industry so long as new cultivars from the breeding program are available to all farmers, and so long as there is no significant charge for the intellectual capital embodied in these varieties.

## Evidence for Emerging Trends in Plant Breeding

In a number of other countries, there has been a stronger tradition of private plant breeding for many years. For instance, in Europe private companies played an important role in the development of modern plant breeding. There also has been a strong private plant breeding sector in the U.S. since at least the development of hybrid corn. Furthermore, as noted by Heisey, Srinivasan, and Thirtle (2002), it continues to expand at the expense of the public system:

"Real inflation-adjusted investment in public-sector plant breeding in the U.S. rose until the 1980s but began to stagnate during the mid-1990s, followed by a decline. In contrast, from the mid- 1960s to the mid-1990s, real private-sector investment in plant breeding grew at a remarkable 7 percent annually. Comprising only one-sixth of the public-sector total in the 1960s, private-sector plant breeding surpassed public investment by the mid-1990s."

"the area of the U.S. planted to field corn is dominated by hybrids developed in the private sector. Private sector hybrids also dominate in the Union and in Canada."

The rapid privatisation of canola breeding in Canada provides a further indicator of the possible future for other public plant breeding programs, and has been comprehensively documented and analysed by Phillips (1999). The following brief overview of selected highlights was summarised from his recent report.

As recently as 1982, there were only six canola cultivars actively grown in the world, and all were bred by public sector institutions in Canada. The plant breeding program used largely non-proprietary technologies, and all seeds produced and sold were in the public domain. The rate of development of new varieties was also relatively slow, with an average of one new variety every two years, and the average lifespan of a cultivar was about 10 years.

In the mid 1980's, four key factors led to the infusion of private money. First, health research and market development efforts throughout the 1980s opened the market for expanded production. Second, breakthroughs in breeding methodologies improved the economics of private sector breeding. Third, financial deregulation in the early 1980s in North America led to a large pool of capital seeking new investment opportunities, which coincided with the budget crunch in universities and public institutes and new pressures to commercialize new technologies for profit. The fourth and perhaps most crucial factor was the introduction of intellectual property rights for biological inventions.

Between 1982 and 1997, a number of new proprietary technologies replaced the publicly developed breeding methods and more than 125 new varieties were introduced. By 1996, private companies developed more than 75% of the new varieties, while public institutions only developed about one quarter of the seed sold in Canada. The average active lifespan of a cultivar declined to about three years by 1997.

In Australia, the situation differs from crop to crop. For many of the minor crops, such as lupins, there is virtually no private sector involvement in plant breeding, and little evidence of any commercial interest in future investment. On the other hand, breeding for most of the major crops, such as wheat and canola, is in transition from a mixed system with a strong public program and some private plant breeding to a system dominated by private plant breeding.

During the 20<sup>th</sup> century, most wheat breeding was carried out in separate state based public programs. According to Kingwell (2003, p3), federal and state governments "channelled funds to universities, state departments of agriculture and a few institutes who, through cooperation and competition, undertook varietal development for farmers." From about 1990, there was a growing perception that the system was broke, or at least struggling, and debate intensified about how it should be changed.

After several years of discussion, GRDC has signalled its intent to consolidate and to corporatise the wheat breeding programs that it supported. This process is now well under way, and GRDC has switched its support from Australia's eight existing and mainly state-based breeding programs to three new commercially focussed wheat breeding programs. These are Sunprime (partners are The University of Sydney, Graincorp, and GRDC); Australian Grain Technologies (partners are The University of Adelaide, the South Australian Research Development Institute, and GRDC); and Enterprise Grains Australia, which is a joint venture between GRDC, the WA Department of Agriculture, NSW Agriculture and the Queensland Department of Primary Industries.

In addition, there are several private wheat breeding firms, including Longreach and Grain Biotechnology Australia (GBA). Longreach reportedly will invest \$14m in wheat breeding over the next 5 years<sup>[1]</sup>, and is a joint venture between AWB Ltd. and Syngenta which has wheat breeding programs in UK, France, US, Canada and NZ. GBA is a company largely owned by the Council of Grain Growers Organisation (COGGO), and by the Export Grain Centre (EGC), which through its investments is providing Australian grain growers with an opportunity to co-invest in some start-up plant breeding companies that are committed to meeting the needs of local growers.

EGC and COGGO also have invested in Canola Breeders Western Australia, which is one of several private plant breeding companies that now dominate canola breeding in Australia. Other private canola breeding companies include Pacific seeds (a member of the Advanta group of companies), Monsanto (through AgSeeds which produces some varieties bred through the Victorian state government breeding programme), Nugrain (owned by Nufarm, Graincorp, Ausbulk, Cooperative Bulk Handling, and Landmark, and produces some varieties bred through the NSW state government breeding programme), Pioneer Seeds, Bayer Crop Science.

## Reasons for Privatisation of Plant Breeding

Plant breeding can be conceptualised as an investment that develops improved varieties with the potential to generate future benefits in the form of improved crop productivity, reduced costs of production, and/or higher returns. Potential value from improved cultivars will be realised only if and when farmers adopt these cultivars in their cropping systems, AND when consumers willingly purchase the food or other crop products in a competitive market. Growers will only adopt these new varieties if they provide real financial benefits that exceed the costs of adoption, including any additional costs of acquiring the improved variety. Similarly, consumers will only knowingly purchase food from these new varieties if by so doing they derive a net benefit in the form of enhanced attributes and/or lower prices relative to available alternatives. In common with other forms of investment, the rate of return will depend on the discounted value of the flow of future benefits net of present value of all costs necessary to generate such benefits.

Arguably the most important reason for the growing trend to privatisation of plant breeding has been significant changes in the ability of plant breeders to appropriate at least some of the benefits from improved grain varieties that otherwise would be captured by growers. Specifically, the incentive for firms to invest in plant breeding depends on the ability to exclude grain growers, and often competing plant breeders as well, from commercial exploitation of a

breeder's varieties unless they pay to do so.

For some crops such as corn, the development of hybrid technology provided genetic copy protection that enabled plant breeders to capture much of the value from heterosis as well as other superior traits. For other crops, it has been the expanding scope of intellectual property rights that has enabled the capture of some of the value created by plant breeding.

So while it has been the application of modern science to plant breeding that has generated much of the potential for value creation in the grain supply chain, it has been extensions to the legal framework for intellectual property rights that have made possible private capture of enough of the value created by plant breeding to provide the private sector with an incentive to invest more in plant breeding. The most significant of these intellectual property rights are patents and Plant Breeder's Rights. In recent decades, both court decisions and legislative changes have expanded the scope and impact of these two types of intellectual property right appreciably.

Complementing these developments in the institutional framework have been scientific discoveries that led to greater potential for value creation by improvements in plant breeding methods. Apart from hybrid technology, other recent advances include new technologies that improve the efficiency of all plant breeding, including both conventional and transgenic plant breeding. Such techniques include double haploidy, plant regeneration systems, molecular based hybrid technologies, and marker assisted selection. Use of these techniques in conventional plant breeding is already reducing the time lags from initial crosses to release of new varieties. Potentially beneficial outcomes from the application of these technologies to plant breeding include one or more of the following:

- cheaper[2] development of improved crop varieties.
- faster/earlier development of improved crop varieties.
- development of superior[3] improved crop varieties, that are more productive, produce better quality grain, or both.

In addition, there has been the more controversial development of transgenic technologies used to produce GMO's. Potential beneficial outcomes from transgenic technologies include:

- development of improved crop cultivars with novel[4] agronomic/input traits that enable lower average costs of production.
- development of improved crop cultivars with novel quality-enhanced traits for which consumers are willing to pay a price premium.

On the other side of the coin, publicly funded rural research has been under pressure for at least the last two decades. In part, this been due to a growing perception that grain growers have been the primary beneficiaries of the traditional plant breeding programs. Historically these programs have been funded mainly from consolidated revenue. To some extent, this concern has been addressed by the relatively recent evolution of the GRDC and similar bodies that rely heavily on collective industry funding to support much of their investments, but the fact remains that a significant part of plant breeding programs is still publicly funded.

Governments also now demand greater accountability at the same time that they reduce funding for agricultural research and extension. As a result, many "public" institutions are under pressure to become at least partially self-funding, and are starting to charge for selected goods and services. Public research institutions also seek to patent and/or commercialise discoveries made in the course of government funded research, or pursue opportunities to license technologies to the private sector.

Public plant breeding programs have not been immune to government pressure to generate revenue from their activities. Like private business, their capacity to capture a high proportion of the net benefits of new varieties depends on:

- a legal basis to establish ownership of the intellectual property embodied in the variety,
- the capacity to exclude potential users who are not willing to pay the nominated price,
- the costs of monitoring and enforcing compliance,
- the capacity for price discrimination.

Pricing practice by public institutions is still evolving. If they start charging significant fees at levels approaching full cost recovery, and exclude farmers unwilling to pay these fees from access to new varieties, then they cease to be public plant breeding organisations within the meaning of the term in this paper.

Finally, agronomic practice by grain growers has become increasingly sophisticated and much more tactical. In particular, many growers now make decisions about which varieties to grow each season on the basis of the latest

possible information about the climatic outlook and other seasonal indicators, such as soil moisture levels as well as weed and disease threats. Consequently they are less likely to use seed saved from the previous harvest, and more likely to purchase new seed of the desired variety from a seed merchant. This change in farming practice will increase the size of the seed market, and improve the economics of private plant breeding.

### Value Creation and Capture Issues

It is inevitable that the growing privatisation and commercialisation of plant breeding in the Australian grains industry will lead to increased competition between plant breeders. While this trend is seen as threatening by some people, there are compelling grounds for viewing this change as an opportunity to create more value for the industry and the nation provided that certain conditions are met. First though the way in which plant breeding creates value is discussed.

In a market economy, the ultimate determinant of the aggregate value of all activities in the food supply chain is the amount that consumers are willing to pay to consume end-products. Value creation occurs when there is an improvement at any step in the supply chain that increases aggregate value in consumption. Market forces, mediated by the institutional and policy framework, including intellectual property rights, will determine the extent to which value is captured at various stages along the supply chain.

In the grains industry, the potential exists for new varieties to create value by lowering the cost of producing and delivering grain and grain products to consumers; and/or by enabling the production of superior grain products for which consumers are willing to pay higher prices. This potential for value creation will be realised when new varieties from the breeding program are released and adopted by grain growers, and the resulting products are purchased and consumed by end-users.

The application of modern science to plant breeding has dramatically increased the potential to create extra value in the grain supply chain. As noted above, new plant breeding methods such as di-haploidy, embryo rescue, and rapid breeding cycles have sped up the development of new varieties and reduced breeding costs. Furthermore, molecular marker technology enables breeders to be much more selective and effective at identifying desirable traits in germplasm collections and incorporating these traits into elite lines. Transformation technologies have significantly expanded the range of traits that plant breeders can access.

Greater value will be created if plant breeders can produce more and better varieties faster and cheaper. To fully realise this potential for value creation, more rather than less investment in plant breeding is needed, and plant breeders need to take a more selective and strategic approach to plant breeding decisions.

For reasons already discussed, less rather than more public funds are likely to be available for investment in plant breeding, so most new investment will need to be privately funded. Funds will be forthcoming only if prospective rates of return from private plant breeding are sufficiently attractive, and this will depend on the extent to which market forces and intellectual property rights allow and enable breeders to capture the value that they create.

Innovation involving changes to established practice in plant breeding is essential to take full advantage of the availability of the new breeding technologies. Sometimes organisations are able to achieve such a transformation in the absence of competitive pressures, but often they cannot. For both public sector organisations and private firms, competition commonly provides the necessary impetus to drive change and risk taking.

Notwithstanding the potential benefits from privatisation, some people perceive threats to the interests of grain growers and/or to the national interest. Some threats are more imagined than real. Other threats are real enough for some individuals or groups, but are outweighed by broader community benefits. There also are some legitimate grounds for concern about institutional arrangements that could limit the efficiency gains from a more competitive plant breeding system.

One possible outcome of greater privatisation of plant breeding is that a small number of large multi-national firms crowd out other competition, and that they might then exploit their market power to capture almost all of the value created by plant breeding. Pricing practices by these large life science companies also might threaten future competitiveness of other sectors of the farming industry, as well as limiting widespread value creation.

The commercialisation of Bt cotton by Monsanto in the USA and in Australia provides one such example. Bt cotton was commercially introduced in the USA in early 1996, and later the same year in Australia in time for the 1996/97 growing season. Monsanto Corporation is the patent holder for the Bt technology, and sought to appropriate the benefits generated by its intellectual property through a technology fee. In the USA, the initial level of the technology fee charged to cotton growers was US \$32/ acre. In Australia, Monsanto set the technology fee at A\$245/ha, which at then current exchange rates translated to about US \$70/acre, or approximately double the level set in the USA.



Even though Monsanto subsequently introduced some concessions in response to pressure from the domestic industry, Australian cotton growers still ended up paying a considerably higher technology fee than their US counterparts.

The considerable monopoly power that the large life science companies possess over proprietary key enabling technologies for plant breeding also is a possible threat to continued technology development in a country such as Australia. Arguably, legal disputes over intellectual property rights that block widespread utilisation and/or further development of the technology pose a major threat to long run value creation from transgenic technologies. Concerns have been expressed about possible patent gridlock, excessive secrecy and duplication of inventive effort, excessive transaction costs to license patented technology, prisoner dilemma type impasses, and/or the "tragedy of the anti-commons". Such supply side problems might tie up the technology in the courts and block commercial implementation for years, if not decades. It also may threaten the *freedom to operate* for public and local industry research and plant breeding programmes.

Given examples such as this, it is not surprising that Australian grain growers have already demonstrated a willingness to fund local plant breeding firms to forestall such a threat, and to ensure ongoing access on reasonable terms to locally bred varieties that maintain Australia's competitive advantage in international grain markets.

Finally, there are real concerns relating to the provision and utilisation of certain key "knowledge rich" inputs to the plant breeding process. Examples of these "knowledge rich" inputs include germplasm collections of land-race and elite breeding lines, and results of pre-breeding research such as agronomy; biometry; entomology; genetic mapping and molecular marker development; germplasm collection and conservation; information and database systems; molecular biology research; plant pathology; plant physiology; plant quarantine; product chemistry; and quantitative genetics.

Most such inputs are key enabling technologies for plant breeding that provide the foundation for ongoing long-term variety improvement and consequent productivity gains. Effectively, they also are non-rival in use by competing plant breeders because they are largely knowledge based. Where knowledge is embedded in a tangible technology, the use of which requires consumables that are rival in use, the knowledge component of such technology is still non-rival in use. In effect, the knowledge component enables a capacity to practice the technology that is unlimited, and hence non-rival in use. Hence they share at least one key attribute of a public good, in so far as use by any one plant breeder does not diminish the value of the input to other plant breeders. For reasons to be discussed below, this capacity to practice key enabling technologies will be referred to as essential plant breeding infrastructure (EPBI).

Traditionally, such inputs were non-proprietary, provision was publicly funded, and access by public plant breeding programs was free and open. In return, no attempt was made to recover the costs of the breeding program (as distinct from costs of seed multiplication) by charging growers for the intellectual property embodied in newly released varieties.

In a world of privatised plant breeding, these admirable arrangements are unlikely to survive. Current funding sources for the provision and further development of key enabling technologies already are under threat. As a result, public agencies may abandon such activity to the private sector, and/or may seek to recover some or all of the cost by charging plant breeders for access to these technologies. This is likely to hasten an emerging trend toward greater application of intellectual property rights to breeding technologies as well as to germplasm, and to the commercialisation and possible privatisation of their production.

If key enabling technologies are proprietary or otherwise price excludable, then they belong to a class of goods referred to as excludable public goods. This may provide the necessary incentive for private sector investment to compensate for declining public and/or collective industry funding. If it does not, eventually innovation and consequent returns to private investment in plant breeding are likely to stall as a result. However, the stimulus to inventive activity provided by the patent system in other areas demonstrates that private provision of excludable public goods is feasible, and may have advantages vis-à-vis public provision of pure public goods.

Nonetheless, there also are threats to the efficient provision and utilisation of EPBI that need to be addressed if the potential benefits from some form of privatised provision of key enabling technologies are to be fully realised. For instance, if private firms respond individually rather than collectively, there will be wasteful duplication of effort in producing such inputs as commercial plant breeders strive for competitive advantage in the market place. Moreover, there is the risk that the incentives for an individual private investment will be inadequate for it to substitute fully for the likely withdrawal of public funding.

Either of these two scenarios is inefficient. The obvious solution is for cooperative behaviour to provide such inputs.

This may involve joint funding by private plant breeders, such as international consortia formed to develop molecular marker technology. However, given the history of funding of plant breeding, the more likely scenario for most EPBI is a continuation of collective funding by industry through a body such as the GRDC. Note that while "membership" of GRDC is compulsory for all producers of mandate grains, the cost of membership is linked to the level of grain production. Nevertheless, there is increasing pressure for GRDC to commercialise those enabling technologies in which it invests, and to recoup at least part of the cost of its investment by way of user fees. Irrespective of whether funding for future provision of essential plant breeding infrastructure comes for collective funding or private investment, it is highly likely that there will be a lack of competition in the provision of essential plant breeding infrastructure.

While adequate and efficient provision of EPBI is one cause for concern, efficient utilisation is another. These inputs are quasi public goods in the sense that they are non-rival in use. As a result, efficient utilisation involves both the potential for under-utilisation of essential plant breeding infrastructure due to monopoly pricing<sup>[5]</sup>, and the much maligned concept of the "level playing field" in downstream industries. Economists' interest in this concept stems from the observation that if the institutional, policy, or legal framework confers advantages on some firms relative to others, competition may not generate desirable outcomes. If the favoured firms are not the most efficient, the outcome may be that inefficient producers out-competing their more efficient counterparts. Conversely, if all firms compete on a "level playing field", then the law of the jungle should ensure that only the most efficient survive.

There are obvious parallels here to National Competition Policy (NCP) principles governing access to essential infrastructure. The aim of National Competition Policy (NCP) is to facilitate effective competition where competition between suppliers of goods and services result in lower prices, a wider range of products, and/or better service for consumers, but also to accommodate situations where competition does not have that effect, or where it conflicts with social objectives.

In industries such as telecommunications, air and rail transport, and electricity transmission, NCP recognises that competition may not be feasible or desirable in the provision of some essential infrastructure, and that the shared use of such 'bottleneck' or 'essential' infrastructure facilities may be necessary to facilitate efficient competition in downstream markets that use such infrastructure. Access regulation that aims to promote competition in markets that use the services of 'essential' infrastructure while preserving incentives to develop and maintain those facilities have been developed to address concerns about denial of access and/or monopoly pricing of access.

A case can be made that, as plant breeding becomes increasingly privatised, equivalent access regimes will need to be developed for essential plant breeding infrastructure (EPBI). Unless such an access regime is established, some of the potential benefits from scientific discoveries underpinning modern plant breeding may not be fully realised. In common with NCP access regimes, the aim should be to promote full and efficient competition between plant breeders, while preserving adequate incentives for investment in the ongoing development, maintenance, and provision of essential plant breeding infrastructure.

GRDC, as the key provider of EPBI for crop breeding, is cognisant of this problem, and is working to develop policies for access by all plant breeders to essential plant breeding infrastructure in which it invests. A key issue that will need to be addressed in these policies is the grounds (if any) for denial of access or for discriminatory pricing. For example, one possibility would be to deny access to, or charge higher prices for EPBI to large multi-national "life science" firms. A possible ground for doing so would be that these multi-national firms have access to other sources of EPBI from which Australian plant breeding firms are excluded.

Another possible ground would be that GRDC has invested in selected plant breeding firms. Fears have been expressed that they may decide to "protect" such investments by limiting other plant breeders' access to GRDC funded EPBI. *Prima facie*, denying access or discriminatory pricing for this reason would seem to be an example of exploiting market power in order to benefit owned or related entities in upstream or downstream markets. Specifically, it would inhibit rigorous competition in the downstream plant breeding market. Nevertheless, there may be grounds for treating overseas owned plant breeding firms differently to domestically owned firms because of the potential impact on Australia's trading position.

## Conclusions

As plant breeding for the Australian grains industry becomes increasingly privatised, equivalent regimes will need to be developed for access to those "knowledge rich" inputs to plant breeding that are essential plant breeding infrastructure (EPBI) so that the potential benefits from scientific discoveries underpinning modern plant breeding are fully realised. In common with NCP access regulation, the aim should be to promote full and efficient competition between plant breeders, while preserving adequate incentives for investment in the ongoing development, maintenance, and provision of essential plant breeding infrastructure.



Issues of pricing policy also requires study even if essential plant breeding infrastructure is to be made "freely" available to all plant breeders at uniform prices, and in a non-discriminatory manner. On the one hand, because there is an imbalance between the bargaining position of the provider of EPBI and third-party plant breeders seeking access, the potential exists for monopoly pricing that would be to detriment of Australian grain growers in international markets. On the other hand, if the eventual aim is to provide a basis for privatisation of the provision of EPBI, the uniform prices will need to be high enough to maintain the incentive for ongoing provision of the optimal level of EPBI.

Due to a lack of competition, private providers of excludable public goods, including essential plant breeding infrastructure, have considerable latitude in setting prices, including uniform prices. Furthermore, price discovery by market processes can not be expected to produce prices that achieve an efficient balance between these conflicting needs because by definition, EPBI is non-rival in use. Analysis of these pricing issues is the subject of ongoing research.

## Bibliography

Brennan, Geoffrey and Walsh, Cliff (1981) "A Monopoly Model of Public Goods Provision: The Uniform Pricing Case". *American Economic Review* 71(1): 196-206.

Brennan, Geoffrey and Walsh, Cliff, (1985) "Private Markets in (Excludable) Public Goods: A Re-examination". *Quarterly Journal of Economics* 100(3): 811-19.

Brennan, John P. and Fox, Paul N. (1998) "The impact of CIMMYT varieties on the genetic diversity of wheat in Australia, 1973-1993". *Australian Journal of Agricultural Research* 49:175-8.

Burns, Michael E. and Walsh, Cliff, (1981) "Market Provision of Price- excludable Public Goods: A General Analysis". *Journal of Political Economy* 89(1): 166-91.

Clements, R. J., Roseille, A. A. and Hilton, R. D. (1992) *National review of crop improvement in the Australian grains industry*. Report to the Board of the Grains Research and Development Corporation.

Frey K.J. (1996) *National Plant Breeding Study - I: Human and financial resources devoted to plant breeding research and development in the United States in 1994* Special Report 98, Iowa State University,

Fuglie, K. and Walker, T.S. (2001) "Economic Incentives and Resource Allocation in US Public and Private Plant Breeding." *Journal of Agricultural and Applied Economics* 33:459-473.

Fuglie, K., C. Klotz, and Gill, M. (1996) "Intellectual Property Rights Encourage Private Investment in Plant Breeding." *Choices. The Magazine of Food, Farm, & Resources Issues* 1<sup>st</sup> Quarter 1996:22-23.

Godden, D. (1998) "Growing plants, evolving rights: plant variety rights in Australia." *Australasian Agribusiness Review* 6: 1-54.

Godden, D. (1982) "Plant Variety Rights in Australia: Some Economic Issues." *Review of Marketing and Agricultural Economics* 1: 51-95.

Heisey, Paul W., Srinivasan, C.S., and Thirtle, Colin (2002) "Public-Sector Plant Breeding in a Privatizing World" *Agricultural Outlook* (January-February) 2002: 26-29.

Jarrett, F. G. Rural Research Organisation and Policies. Williams, D. B. Agriculture in the Australian Economy. 82-96. 90. South Melbourne, Australia, Sydney University Press.

Kingwell, R. (2003) "Institutional Change and Plant Variety Provision in Australia" Contributed paper presented to 47th Annual Conference of the Australian Agricultural and Resource Economics Society, Fremantle, February 12-14, 2003.

Lindner, B. (1999) "Prospects for Public Plant Breeding in a Small Country", paper presented to the ICABR Conference on *The Shape of the Coming Agricultural Biotechnology Transformation: Strategic Investment and Policy Approaches from an Economic Perspective* at University of Rome "Tor Vergata" Rome, June 17-18-19, 1999.

Lindner, B. (2002) "Access by plant breeders to collectively funded research and other services in an increasingly privatized world". In McComb JA (Ed.) *Plant Breeding for the 11th Millennium*. Proceedings of the 12th Australasian Plant Breeding Conference, Perth, Western Australia 15-20 September 2002. pp. 593-597.

Lindner, B. (2004) "Privatised provision of essential plant breeding infrastructure", *Australian Journal of Agricultural and Resource Economics* 48(2), forthcoming.

Phillips, Peter W. B. (1999) IPRs, Canola and Public Research in Canada. Saskatoon, Canada: University of Saskatchewan, (mimeo).

Productivity Commission (1999) *Impact of Competition Policy Reforms on Rural and Regional Australia*, Report no. 8, AusInfo, Canberra.

Reeves, T.G. and Cassady, K. (2002) "History and past Achievements of Plant Breeding." *Australian Journal of Agricultural Research* 53:851-863.

Thirtle, C., et. al. (1998) "The rise and fall of public sector plant breeding in United Kingdom: a causal chain model of basic and applied research and diffusion." *Agricultural Economics*. 19:127-143.

Watson, Alistair S. (1997) "The impact of plant breeders rights and royalties on investment in public and private breeding and commercialization of grain cultivars." (mimeo).

Wright, B.D. (1998) "Public germplasm development at a crossroads: Biotechnology and intellectual property." *California Agriculture* 52:8-13.

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[1] The Australian, 9/3/2002 -

[2] i.e. relative to varieties with equivalent characteristics to those currently being produced by conventional plant breeding methods.

[3] i.e. In this context, these are varieties that have superior performance to those that could be bred economically by conventional plant breeding methods.

[4] i.e. traits that could not have been incorporated economically into improved varieties by conventional plant breeding methods.

[5] This topic is addressed more fully in Lindner (2004).