WATER RIGHTS
IN RURAL NEW SOUTH WALES

CIS Policy Monographs 26

WATER RIGHTS

IN RURAL NEW SOUTH WALES

THE EVOLUTION OF A PROPERTY RIGHTS SYSTEM

Gary L. Sturgess

and

Michael Wright

THE CENTRE FOR
INDEPENDENT
STUDIES

1993

Foreword

One of the fundamental lessons from economics is that incentives matter. But too often this lesson is ignored when it comes to natural-resource and environmental policy. Governments around the world continually subsidise resource use, encouraging wasteful practices and pitting bureaucracy against the environment.

This has been especially true of water. Dams and delivery systems are constructed and operated with little thought given to efficiency or environmental quality. It is said that water runs uphill to money. It gushes uphill to politics. Not only do projects fail benefit-cost tests, but they often destroy the environment in the process. In the United States, for example, a congressional report recently estimated that benefits from the Central Utah Project amounted to only 30 cents for every tax dollar spent; yet Congress approved funding the project. The water will be applied with pesticides and herbicides to fragile lands to produce subsidised farm products.

As the folly of such programs is being exposed, policymakers around the world are being forced to consider the efficiency of markets as a way of getting the incentives right. Gary Sturgess and Michael Wright document the process whereby this is happening in Australia. Without dwelling on theory, they point out that allocative institutions make little difference if resources are not scarce; but as scarcity increases, pressure mounts for institutional change. On the early American frontier, this pressure forced farmers and miners to devise a water system that clearly defined individual rights, made them transferable among alternative uses, and allowed owners to sell their rights to other users.

The same pressure from scarcity has come much later to New South Wales, but the results have been similar. Gary Sturgess and Michael Wright document the evolution of a water-rights system that has allowed markets to encourage water-use efficiency and fiscal accountability. Their story is not one of unbridled market forces working in a world of anarchy, but rather one of how the government met its obligation to establish and enforce clear rules within which water users could operate. The lesson for policymakers is that governments can either muck up the process by subsidising water use and attempting bureaucratic allocation, or promote efficiency through the appropriate legal framework. Fortunately, New South Wales has chosen the latter.

The evolutionary process is still at work in New South Wales, especially in the case of in-stream or environmental use of water. Clearly specified rules for agricultural, municipal, and industrial uses evolved first, but the legal framework is evolving to integrate environmental quality. As with surface uses, the discipline of the marketplace

for in-stream uses is crucial if environmental quality is to get its due.

'Above all else, the policymakers need to demystify the academic literature', conclude the authors, 'to strip away the jargon and explain to politicians, public servants and private stakeholders the advantages and the limitations of market solutions to natural-resource allocations'. They have done a masterly job of accomplishing this task with respect to water, and the people and environment of Australia will benefit all the more if their message is applied to other resources.

Terry Anderson
Political Economy Research Center
Bozeman, Montana

About the Authors

Gary L. Sturgess was, until recently, Director-General of The Cabinet Office in the New South Wales Government. He was the principal policy adviser to the former Premier of New South Wales, Nick Greiner, from 1983 to 1992, and occupied a similar position under Greiner's successor, John Fahey. He is a lawyer by training who has taken a particular interest in property-rights theory.

Michael Wright is currently Senior Policy Officer in the Natural Resources Branch of the New South Wales Cabinet Office. He holds a Bachelor of Arts (English Literature) from the University of Sydney and a Bachelor of Commerce (Economics) from the University of New South Wales. He has worked in both the private and public sectors, and was Manager of Research and Publications with the Australian Association of National Advertisers.

Preface

Environmental concerns have recently focused public attention on the inherent scarcity of our natural resources and the need for new and more flexible mechanisms for regulating their use. Responding to this demand, Australian policy analysts have recently begun to explore the potential of economic instruments — property rights, pricing and taxation incentives — in environmental regulation.

In his 1990 Earth Day statement, the then Premier of New South Wales, Nick Greiner, raised, for the first time in public debate in this country, the potential for using economic incentives to protect our 'common' resources:

> We must now learn to apply to these precious and scarce resources the same care and discipline which we as individuals would apply to our own personal property and resources. . . That means that the Government, on behalf of the community, must act as if it were the owner of these resources. (Greiner, 1990)

Shortly thereafter, in its June 1990 *Economic Round-up*, the Commonwealth Treasury put the case for making private property rights in natural resources transferable in order to help redress the over-use and abuse of these resources.

Since then a flood of publications, both public and private, has appeared recommending the use of market mechanisms to help manage Australia's natural resources. These include Moran et al. (1991); Anderson (1991); Bennett & Block (1991); the final report of the Ecologically Sustainable Development Working Groups (1991); the Economic Planning Advisory Council (1992); and the Bureau of Industry Economics (1992).

The present monograph is based on a paper written for a Water Forum conducted by the Minister for Water Resources in the NSW Parliament in July 1990. It describes the evolution of a system of tradable property rights in water in rural New South Wales throughout the 1980s. It was written to show that policymakers in New South Wales had successfully implemented a system of tradable permits in the State's regulated river valleys and irrigation areas. Our thesis is that property rights are not only sound in economic theory; they work in the real world. Moreover, the fact that this experiment had begun under a Labor government and had been extended under a subsequent Liberal-National administration suggests that there would be bipartisan support within Australia for property-rights solutions to environmental problems.

This is not primarily a theoretical study. With the exception of a brief introduction to property-rights theory, it is based on primary research undertaken with the NSW Department of Water Resources rather than on academic literature.

This monograph was written by serving public officials employed in the central policy department of a State government. Unsurprisingly, it was written in a conservative tone that reflected the occupation of its authors.

Chapter 1

A Property-Rights Approach to Resource Allocation

Society would benefit if entitlements to make decisions about our natural resources were clarified. This is hardly a strong claim to make; indeed, given the limits of planet Earth, some would regard it as self-evident. But when translated into the language of property rights, the proposition becomes more controversial, and the benefit of clearly allocating — to governments, communities and private users — 'decision-making entitlements' concerning natural resources needs to be demonstrated. But if property rights (in the economist's sense of the term) are nothing other than entitlements to make decisions about the use of resources, then the issue is not so much whether or not to have a property-rights regime, but whether or not such a regime meets society's needs at the lowest cost.

Fortunately, this is no longer just a matter of academic speculation. Reconstruction of the allocative process for surface-water resources in rural New South Wales has confirmed that the establishment of a system of tradable property rights brings real gains. This has involved the creation of a market in water rights through more effective regulation of rural water by government and the establishment of a strict regime of user entitlements and tradability in water rights.

Markets in natural resources have usually emerged in response to increasing resource scarcity; and this has largely been the case for surface-water resources in rural New South Wales. While surface water was in abundant supply and could be consumed freely without detracting from the needs of other users, there was little demand for government regulation of its use and certainly no requirement for a market in tradable water entitlements. But with escalating demands and increasing water scarcity, government was faced with two options. The first was to continue to permit users to consume water on a first-come–first-served basis. Once the resource was fully allocated, this would have resulted in some low-value users enjoying supply priority based on historical precedent and at the expense of potential higher-value users.

Such over-use of the resource would have had severe implications for water quality, which is simply another dimension of water scarcity. Indiscriminate use of river systems would have eventually resulted in their becoming polluted and of lower value to users further downstream.

The other option — and, once scarcity had become a problem, the only option — was to regulate the consumption of these resources and to

allocate them among the different competing needs. But upon what criteria, based on what information, are such allocative decisions to be made?

Bureaucrats are notoriously less efficient than markets at making these kinds of allocative decisions. The difficulty of bureaucratic second-guessing was well described by C. Jackson Grayson, who presided over Phase II of US President Nixon's Wage and Price Control program in the early 1970s:

> The problem that policy-makers must cope with, if they are determined to control the system, is the endless detail that is involved in the operation of the system. To control the system and yet keep it running smoothly, the authorities must intercept all of the signals coming from the system (and there are hundreds of millions), interpret them, appropriately change them (assuming they know how) and retransmit them. (Grayson, 1978:203–4)

Governments are now beginning to accept what economists have been telling us for some time: that where it is technically and economically feasible for government to establish and to enforce a property-rights regime, it is vastly more efficient to rely on a market system to make allocative decisions than to attempt to dictate conditions centrally. And as resources become increasingly scarce and as the premium placed on efficiency grows, governments of all political persuasions, in Australia as elsewhere, are turning to market solutions to make these kinds of decisions. Over the past decade, governments in New South Wales have come to rely on a market for property rights in surface water for the allocation of rural water resources.

This study analyses the evolution of this market and the conditions that were necessary (and sufficient) for such a system to develop. It is argued that because of increasing scarcity and competitive international pressures for greater efficiency, this water-rights regime will continue to mature, and that this will happen regardless of which political party is in office at a State or national level.

Chapter 2 provides a brief introduction to some of the principal concepts in property-rights theory, including the conditions necessary for a market in property rights to come into existence.

Chapter 3 charts the development of a market for property rights in surface water in rural New South Wales against a background of increasing resource scarcity. In the fourth chapter we describe some of the characteristics of the resource that have been factored into the generation of prices within this market, including charges for costs incurred by government in water delivery and supply reliability.

Chapter 5 considers some of the constraints that are impeding further

market maturation, beyond technical limitations on the physical transfer of water. It is contended that economic and political self-interest have conspired to limit development of the market.

This is followed in Chapter 6 with a brief examination of the growing sophistication of the market. Consideration is given to prospects for arbitrage trade in water rights, auctioning of water rights, and trade in groundwater. We also discuss the potential for government to grant windfall gains to water users through poor market design and implementation.

Chapter 7 focuses on the opportunities for the modification of water rights to incorporate water-quality impacts and the allocation of 'in-stream' rights. The chapter concludes with a discussion of the possibility of establishing a market in tradable discharge rights to operate concurrently with existing rural water markets so as to better protect the quality of the resource.

Chapter 2

The Development of Markets in Natural Resources

There is no intrinsic merit in developing markets in natural resources. Here, as elsewhere, our decisions should be influenced by the relevant costs and benefits of such reforms. The legal and social infrastructure required for the creation of a new market is substantial, and consumes resources that might be used more productively elsewhere. It follows that the development of markets in natural resources will not be justified until technology has reduced the costs of sub-dividing and precisely allocating the resource in question, and scarcity has sufficiently increased its value.

When a resource is freely available and each consumer can take from the common pool without coming into conflict with the needs of other users, a fully-fledged tradable rights system would seem to have few benefits. In the 15th century, when ocean travel was confined to a few well-known but rarely-travelled routes, there was no demand for a highly developed and internationally negotiated law of the sea. By the latter half of the 20th century, the growing scarcity of some marine resources and the increasing congestion of a few well-travelled sea lanes made agreement on a de facto property-rights regime over the oceans essential (Eckert, 1979).

Over time, many resources previously thought to be inexhaustible begin to deplete, and society finds it necessary to regulate their consumption through legislative and bureaucratic intervention. But as the scarcity of these resources continues to grow and the conflict between potential end-users escalates, centralised planning and bureaucratic decision-making become less able to cope with the complex allocative decisions required. In these circumstances, and when changing patterns of demand and the nature of the resource itself permit, government decision-makers are able to take advantage of property rights and market systems to help society make more sophisticated decisions about the use and allocation of natural resources.

There is now a substantial literature on the conditions necessary for the development of effective markets in natural resources. These are generally identified as: the relative scarcity of the resource; the nature of the resource and the state of technology governing it; and the foundation of an efficient regulatory framework by government to enforce property and contractual rights.

Scarcity as a Prerequisite

According to Harold Demsetz, 'In the world of Robinson Crusoe property rights play no role' (1967:347). Demsetz argued that property rights (and, he could have added, markets) are a social phenomenon; they arise from a common concern at finding ways of encouraging individuals to coexist peacefully. It follows that when a natural resource is so plentiful that it can be used by two or more individuals without their coming into conflict, there is no need for a social solution such as property rights.

By way of illustration, Demsetz described the emergence of property rights amongst the Indians of the Labrador Peninsular during the early 18th century. As the value of beaver furs rose following European settlement, Indian bands that previously had limited use for the beaver arrived at rudimentary agreements and spent time and effort marking out their respective hunting grounds. Until the rising fur trade made the beaver scarce (in relative and, perhaps, absolute terms), the need for this territorial behaviour simply did not exist. Moreover, in conditions of plenty, the effort involved in formally allocating property rights in a particular resource will not be justified. When the first explorers landed on the shores of the Americas they erected monuments and conducted ceremonies by which they purported to appropriate the entire continent in the name of their sponsoring sovereigns. But their claims went largely ignored because of the immensity of the land mass that they claimed and the high costs involved in enforcing their alleged title (Keller, Lissitzyn & Mann, 1938).

The situation was not very different in the electromagnetic spectrum during the early decades of this century. A handful of scientists and radio buffs were free to play across the entire broadcast band with little fear that they would intrude into the domain of other users. Until technology and public demand made the spectrum a scarce resource, talk of creating marketable property rights was meaningless. The electromagnetic spectrum was a vast resource to which access was largely unconstrained and where consumption by one user did not affect anyone else's use of the resource. But by the 1920s interference was threatening to render the electromagnetic spectrum unusable as a reliable means of communication, and governments acted to define entitlements and to introduce some predictability into radio broadcasting. Although governments have thus far refrained from introducing market mechanisms to allocate the spectrum, increasing scarcity has led to the introduction of systems that exhibit many of the characteristics of property rights. A serious debate has arisen about the merits of permitting trading in broadcast rights (de Vany et al., 1980).

Resource Characteristics

Yet even if a resource is scarce, a market in property rights will not evolve unless the resource is physically of a kind that can be exclusively owned

and (preferably) subdivided and recombined with other bundles of the same resource. This is often a function of our state of knowledge, especially our level of technological know-how — as with resources such as the electromagnetic spectrum, oil reserves and underground water systems.

Economists have suggested that three physical characteristics are necessary for the formation of a successful property-rights regime: exclusivity, transferability, and divisibility.

Exclusivity. It is fundamental to a property-rights system that the right to use a particular resource (or part of it) is capable of being allocated exclusively to one person (the owner) who can decide how it is to be used, or, if necessary, when it is to be sold to another user. Unless this condition exists, the resource is unlikely to be put to its most valuable use.

Transferability. Since the value of the resource to different users varies in the light of factors such as climatic and economic circumstances, it is vital that it be freely exchangeable. In a river system there are valid technical reasons for constraining some transferability up and down the river. But these resource-specific constraints aside, to the extent that government restricts exchanges, it will also reduce the efficiency of the market it seeks to create.

Divisibility. It must be possible to limit rights to portions of the resource that are sufficiently small to enable bundles of rights to be broken up, traded, and recombined into new and more efficient bundles. This is essential for efficient resource allocation, and also for market efficiency, in the sense that divisibility improves market 'depth' through increasing the volume of transactions.

Appropriate Legal Framework

Finally, governments have an obligation to lay down clear rules to govern property-rights regimes and to create institutions to permit the inexpensive enforcement of those rights. This involves issues of law enforcement, appropriate tenure, and initial allocation.

Law enforcement and transaction costs. Government has a role to play in law enforcement. If rights are not clearly defined, or if the government does not publicly recognise and enforce the property-rights regime in question, the value of these rights will be reduced and the growth of the market hampered by high transaction costs. No one wants to pay for a right of uncertain status and value, at least not without a substantial discount to compensate for the increased risk. For example, government can improve the definition of water rights by clearly assigning a reliability factor to the water in question, so that users and would-be

purchasers know the probability of receiving their allocation during dry years. If this dimension of the right is not allocated, then all users face greater uncertainty as to the value of their resource and trade will be depressed.

Government might also be able to assist in lowering costs by facilitating the creation of a 'marketplace' in which would-be buyers and sellers know they will be able to trade rights. The existence of stock exchanges considerably reduces the cost of trading in the shares of public corporations. Although historical convention has been largely responsible for the growth of these institutions, their authority has been reinforced by government regulation.

Appropriate tenure. However, governments also need to be careful not to create inappropriate rules that result in perverse incentive structures and exacerbate the abuse of the resource in question. In this regard, it is important that resource tenure not be limited to short-term leases, since resources can be allocated more efficiently when users are able to hold the rights to them over the long term. Leases are an appropriate feature of any mature market, and there is no real difficulty in leasing the rights to a resource instead of selling them in perpetuity. But they need to be of sufficient duration to permit the user to undertake rational planning. Short-term leases often lead to waste and over-use of the resource.

In New South Wales, government conditions on the pastoral leases granted in the arid Western Division of the State exacerbated the environmental degradation caused by European settlement. Small acreages, intensive stocking, five-year leases and leasehold conditions that led to tree removal and pasture stripping were all the product of incompetent government policymaking (Parliament of New South Wales, 1983:291–308).

Initial allocation. Government must be careful to define the rights to the resource so as not to transfer the costs of resource use to others. There may be a case for establishing a property-rights regime for the entire resource that seeks to define the entire system at the outset.

Applied to water resources, this means both deciding how much water there is in a river system to allocate and defining bundles and probabilities that will allocate the entire resource, including in-stream flow requirements. If there are uncertainties ('fuzzy borders'), some users may not get the resource they are entitled to. In a democratic system of government, politicians will be tempted to take advantage of the 'fuzzy borders' to hand out what they perceive to be 'spare' rights to some users.

This consideration is particularly relevant to water quality. As long as quality was not compromised by over-use, this element was ignored in the definitions of water property rights. But as water quality comes to be more

of an issue — as this dimension of the resource becomes more scarce — policymakers are coming to realise that irrigators have assumed that high-quality water is one of the elements of the rights that they have purchased. Because government has not clearly allocated all of the dimensions of these water rights, some users are imposing higher costs on others through reduced water quality.

On the other hand, there is an argument that if government intervenes too early in an attempt to formalise property rights and market systems, it may waste social resources and distort the way in which the market develops. Anderson and Hill (1979) have written about some of the intermediate rights-protection 'clubs' that existed for a time in the American West and warned elsewhere (1983) of the costs of defining property rights compared to the efficiency losses associated with the common. There may be a case for less formalised, semi-governmental structures during the formative stages of a property-rights regime; for example, the Total Catchment Management groups that have been established throughout New South Wales in recent years to take a 'whole-of-resource' look at questions of land degradation and water quality.

If each of the elements discussed above is present, a mature property-rights regime exists in the natural resource in question. Although the system governing rural water allocation in New South Wales is not fully developed, the market that is evolving contains most of the essential elements.

Chapter 3

Property Rights and Water Markets in Rural New South Wales

Water markets and enforceable water property rights in New South Wales are largely the outcome of increasing scarcity. A combination of water shortages and escalating demand has meant that the resource can no longer be put to additional uses without compromising the requirements of existing water users.

Resource Scarcity and Property Rights in Water

Evidence of this growing scarcity in rural New South Wales is largely anecdotal. However, on the supply side and from the government's point of view, scarcity has been formally signalled through the imposition of embargoes on further access to surface water because the resource has already been fully allocated. On the demand side and at the level of the individual water user, the very high transaction costs that water users have been prepared to incur in order to secure additional water suggests that the resource has become more scarce, and therefore more valuable. (These and other indicators of resource scarcity are dealt with in greater detail below.)

Both regulated river valleys on the one hand, and irrigation areas and districts on the other, have been affected. The former include those rivers for which flow is regulated by storage works and from which private irrigators pump water directly on to their landholdings. The latter include those regions where water is delivered to water users by means of government-owned works and channels. In New South Wales, agricultural water users in regulated river valleys and irrigation areas and districts account for 30 per cent and 60 per cent respectively of total regulated water consumption.

This increase in water scarcity has brought about a radical transformation in water property rights, as users have demanded safeguards against the erosion of supply reliability and the government has moved to prevent the exhaustion of the resource. Water users used to have virtually unlimited access to water and almost unrestricted further access to it. Now, their rights to the resource are defined according to a set maximum volume for non-drought periods; and government regulations prevent potential new water users gaining access to the resource, except through the purchase of existing entitlements. And whereas water users were not required to account for the costs involved in water delivery and water use, they are now increasingly being charged on a user-pays basis.

This transformation of water rights to cope with the pressures imposed by resource scarcity has been effected largely through changes to the conditions attached to irrigation water licences. Originally, when water was relatively abundant, water licences were defined to permit irrigation on the basis of an authorised land area, and no limit was placed on the amount of water that might be drawn to irrigate that authorised area. An irrigator who had been issued with a licence to irrigate (say) 400 acres could in theory draw as much water as he desired to irrigate the authorised 400 acres. In practice, some limits did exist, as the then Water Resources Commission (hereafter Water Resources) attempted to monitor the behaviour of irrigators to prevent 'excessive' water usage.

However, this state of affairs could not continue in the face of increasing water scarcity. The solution was obvious: to limit the amount of water that could be drawn under a water licence. This was achieved through the introduction of so-called 'volumetric allocation'. This set annual water-volume limits for licences, so that an irrigator with a 400-acre licence, though still authorised to irrigate only those 400 acres, was now also restricted to using not more than 'x' megalitres of water for that purpose. (Typically, a volume entitlement of 972 megalitres has been attached to a 400-acre licence.)

Volumetric allocations were first officially introduced in June 1981 on the Murray River. However, they had been unofficially in place there since 1975/76. Their official introduction on the Murray was closely followed by similar schemes on other river systems, including the Lachlan, Lower Darling, Gwydir, Macquarie, Hunter and Namoi. Volumetric allocation was introduced on the Murrumbidgee River in June 1983; the Peel River was the last of the regulated river systems to adopt this system (in 1985). But whereas this shift in licence conditions put a cap on the exploitation of water by existing users, it did not solve the problem of new demands for water. The solution to this demanded a mechanism that slowed the entry of new water users — an essential step if water was to be allocated to its highest-value use.

Government's answer was to set embargoes on the issue of new irrigation water licences. These were justified on the grounds that rivers were already fully appropriated and new licences would undermine supply reliability. Administrative embargoes were applied during the 1970s in selected river valleys and areas. This involved Water Resources accepting applications for licences but refusing to process them. This unwieldy and confusing approach was replaced in 1981 with the clean legal instrument of a State-wide statutory embargo on the issue of irrigation licences.

Water scarcity and licence embargoes have not been confined to agricultural water users. An embargo on the issue of industrial water

licences was applied in February 1990, following increasing consumption by industrial developments in rural New South Wales.

It should be noted that the Minister still retains discretionary powers to lift the embargo to allow for the issue of additional licences, to the detriment of existing water users. Not surprisingly, the NSW Irrigators' Council would like to see this discretionary power removed from the Minister.

Transferable Water Rights

Volumetric allocations and licence embargoes were an inevitable response to a regime of water rights that failed to reflect resource scarcity. However, these measures alone were insufficient. Given the absolute limits on the amount of available exploitable water, a decision to use or not use water could directly influence the amount of water available for use by others. This implied that a redistribution of water amongst users might enhance efficiency. Without such redistribution, water would continue to be allocated on the first-come-first-served basis on which licences had been originally issued. If continued, this could well result in low-value users wasting water while high-value users were denied access to it, despite being prepared to pay considerable amounts for it.

If the situation was to change, then the essential interdependence between water users in their use of the resource needed to be reflected in the nascent property-rights regime. This could occur only if those rights were made transferable. In short, if water rights were vested with tradability, the incentive would be created to enable water to move voluntarily to its highest-value use. Yet despite increasing water scarcity, prohibitions on the transfer of water rights remained in place for some years. Only in 1983 were moves made to begin lifting restrictions on water trades. This was achieved through a legislative amendment of the Water Act 1912 providing for the temporary or short-term 'renting' of water entitlements. This allowed some trade in water rights in response to short-term scarcity and laid the foundation for the establishment of true markets in water. But permanent transfers to meet longer-term planning needs were not permitted under this amendment.

As economists have often pointed out, if the permitted tenure of water 'leases' is too short, tradability in water rights may not in itself result in a more efficient allocation of water. If tenure is too short, higher-value water users may decline to take on additional water, since the capital outlay involved in so doing may need to be recouped over a period longer than that allowed by the transfer. Such disincentives were noticeable in the early stages of the development of these markets following the 1983 amendment. Water transfers were permitted only on a temporary basis, most being limited to an annual lease; water rights reverted to the original owner at the close of the year.

However, this was soon followed by temporary multiple-year leases of up to five years. Tenure disincentives in the regulated river valleys were substantially eliminated in August 1989, with the introduction of permanent water transfers. Yet tenure disincentives have still operated in the irrigation areas and districts, where local opposition has slowed their introduction. However, the principle of permanent transfers of water licences is coming to be accepted by the management boards of the irrigation areas and districts and permanent transfers are now occurring in some parts of the State. Permanent transfers between areas and districts continue to face strong opposition.

Water Users and the Introduction of Transfers

The major impetus for the development of water markets came from users rather than government. Although it would be misleading to imply that water users had formed themselves into a unified group to lobby for water transfers — and indeed, as noted below, some users have opposed transferability of entitlements — it is true to say that many water users, faced with the harsh reality of overconsumption, have recognised the mutual gains available from trading in water. It is not surprising that transfers were introduced during the 1983/84 drought; arguably, it was brute economic hardship that generated the political will necessary for the 1983 amendment and subsequent initiatives to free up water transfers. Indeed, some farmers were already taking advantage of water transfers before 1983, by transferring water entitlements under the so-called 'duality of ownership' approach. This involved an individual gaining ownership of two landholdings and transferring the water entitlement from the second to the first. In this way, two water licences could be attached to the first landholding.

The fact that farmers were already engaging in this very costly practice of 'licence stacking' shows that the 1983 amendment did no more than bring government policy into line with existing private practice. Importantly, the amendment reduced the transaction costs involved in water transfer, since it was no longer necessary to pay the cost of additional land in order to acquire additional water.

Given its private origins, it should not surprise us that water-transfer markets have also continued to operate through private transactions. The Department of Water Resources limits its involvement to the collection of an administrative fee to cover processing costs and to the monitoring of transfers to ensure that channel capacities are adequate and environmental consequences are minimal.

As is often the case in the development of property-rights systems, water transfers were not imposed from above, but were very much the response of water users to increasing resource scarcity. All the government

did was to remove the legislative obstacles to transferability. With the arrival of transferable property rights, true water markets were born.

Unregulated Rivers and Water Transfers

Enforceable and tradable property rights in water have tended to be confined to regulated river systems. However, the pressures of growing scarcity have also led to the development of water rights on some rivers not regulated by storage works (the so-called 'unregulated' rivers). Most of the significant unregulated rivers in New South Wales are coastal, the Barwon-Darling being an important exception. Typically, inland rivers are smaller and, for economic reasons, unregulated.

By and large, tradable water rights have not developed on coastal unregulated rivers. This is because, unlike most of the inland regulated rivers, coastal rivers are not fully appropriated, so that water is not in short supply. Thus, a water user who diverts water upstream will normally have little impact on the quantity of water available for downstream users.

In the absence of scarcity, there has been little pressure for the clear allocation of decision-making entitlements to this water; transfers have not been necessary as all water demands can be adequately met from the existing resource. In this case, the enforcement and transaction costs associated with a property-rights system are such as to ensure that efficiency is maximised by the allocation of water not through market mechanisms but on a first-come-first-served basis.

Yet the situation differs markedly on the Barwon-Darling, which, though unregulated, has been fully appropriated and is subject to a licence embargo. Since conditions of scarcity prevail on this river, property rights are both enforceable and tradable.

Chapter 4

Valuing The Resource

An important consequence of defining property rights in natural resources is that decision-makers are enabled to capture the full benefits and are forced to meet the true costs associated with their use of their resource in question. If, as a consequence of investing time and money in the maintenance and the improvement of the resource, decision-makers are obliged to share the benefits with other users, then we would expect them to put less into maintaining the resource than if they were able to capture the benefits exclusively for themselves.

Conversely, if users are charged the full costs of maintaining and developing the resource, including environmental costs, and if those charges are structured in such a way as to send accurate signals about the true costs, then we would expect users to husband the resource more carefully. It follows that pricing reform must be an integral part of any reform that seeks to define and to protect rights to natural resources.

Water Pricing

For several years the New South Wales government has been moving toward a user-pays pricing regime for water supply through its delivery service charge. This is not a charge for the water as such, though it is levied on the basis of megalitres used. Rather, it represents the water user's share of the costs the government incurs in 'running the rivers'. These costs are described within the framework of Department of Water Resources' seven major activities:

- customer advice;
- water sharing;
- water supply;
- environment and catchment management;
- water quality;
- organisational activities;
- asset management.

The total estimated cost of 'running the rivers' in 1991/92 was $8.2 million. Some 70 per cent of these costs (approximately $5.7 million) are being recovered from water users through the delivery service charge. The remaining 30 per cent is met by government in recognition of the public benefits associated with the use of water for environmental, recreational and tourism purposes.

Importantly, water users are now being required to contribute an amount towards the impact of their activities on water quality. While some of this is captured through the delivery service charge, a water-quality levy has been imposed in the Macquarie-Western and Barwon regions to raise additional revenue for a pesticide program to improve water quality in the Macquarie and Namoi rivers.

However, no attempt has been made to incorporate the capital costs of headworks in the delivery service charge. Headworks are classified as 'national assets' and so avoid having their costs charged to a particular group of users. In any case, much of the cost of headworks will already have been capitalised into land values along the rivers, and it would be difficult (and in many cases unfair) to recover these expenditures now. Nevertheless, water users are now also involved in joint ventures with government on new capital projects, such as the Pindari Dam enlargement project. Further, the government and the irrigators have agreed to a joint funding proposal to accelerate asset rehabilitation in irrigation areas and districts. In 1990/91, the irrigator contribution ranged from $0.59 to $1.18 per megalitre.

The shift toward a user-pays pricing regime, though still in its infancy, is a step in the direction of providing a more appropriate incentive structure for encouraging the efficient use of water. The rational irrigator will use water only up to the point at which the benefit from an additional unit of water equals its cost. As water prices more faithfully reflect the true costs of water, the closer we will move towards balancing at the margin the full benefits and costs of water use.

Delivery charges that varied with the costs that individual water users place on the system would generate further incentives for efficiency. Obviously, this would be a refinement on the present relatively blunt-ended user-pays regime, which charges a flat rate per megalitre. This regime suggests that costs primarily reflect quantities of water used; but costs are also often a function of the use to which the allocated water is actually put. However, the costs involved in ascertaining these individual contributions to running the rivers render this further refinement problematic. For the present at least, government must content itself with a charging system that, though not maximising water-use efficiency, at least delivers a general signal to all water users that the costs of running a regulated river system will no longer be wholly subsidised by the government.

Supply Reliability and Licence Security

As well as ensuring the transferability of water rights and moving to ensure that prices more accurately reflect the true cost of water, the government has played a further and crucial role in the delineation of property rights

by assigning a reliability factor to water entitlements. This has given users and potential buyers some indication of the probability of receiving their full allocation and confers greater certainty on the value of these rights. This, in turn, reduces the risks associated with buying water. Some indication of the probability of water being available is essential if the costs associated with transfers are to remain at a level low enough to allow transfers to take place. If risk is too high and the value of the property right is uncertain, water trades will be strongly discouraged.

High-security vs normal-security licences. In most cases, reliability factors have been introduced by attaching two alternative security levels to water licences: 'high security' and 'normal security'. Except in periods of severe drought, high-security licence holders will always receive all of their allocation. High-security entitlements are typically attached to town, industrial, stock, domestic and permanent planting applications, together with some recreational applications such as golf-course greens. In contrast, normal-security licence holders receive what water is available after the high-security allocations have been made and 'prudent' reservoir carry-over for possible future dry periods has been determined. Once high-security allocation has been satisfied and carry-over determined for a given year, the percentage allocation that normal-security licence holders can expect to receive can be determined for each individual river valley and irrigation area and district. For example, after meeting high-security needs and setting aside carry-over, the Department of Water Resources may announce there is water available in storage to meet only 60 per cent of normal-security licence demands for a given year in a particular river valley. This means that normal-security licences can expect to receive only 60 per cent of their entitlement for that year.

The availability of information of this type is critical to irrigators who hold normal-security licences, since it provides an indication of what level of irrigation-based farm activity will be sustainable in a given season. But it also allows purchasers to obtain information about average supply reliability in river valleys and irrigation areas and districts and to calculate the long-term commercial value of water entitlements in different regions of the State. For example, supply reliability for normal-security entitlements in the Gwydir river valley has averaged 45 per cent in recent years. In other words, the odds are that holders of normal-security licences will receive 100 per cent of their allocation in only nine out of 20 years. Average reliability figures such as these encourage transfers by giving potential buyers of water a measure of the general value of a water entitlement in terms of the probability of receiving a full allocation.

Of course, during periods of drought, not even high-security licence holders are guaranteed to receive all of their allocation. Nevertheless, measures are taken by government to reduce uncertainty during dry

periods through rationing water allocation in a definite order of priority on the basis of licence type. This order of priority (from lowest to highest) is as follows:

- normal-security irrigator licences;
- high-security irrigator licences;
- water entitlements for industrial and some recreational purposes (which are high-security by definition);
- water entitlements for stock, domestic and town water use (which are also high-security by definition).

In contrast, during wetter periods, when all water entitlements have been fully met and there is still excess water available, licence holders will often be given the right to divert additional water from waterways, either for immediate use or for on-farm storage. Yet as with regulated flows, irrigators must pay for such 'off allocation flows'.

Differentials in licence-security levels have also led to pressure for transactions to permit the exchange of volume for greater security of supply. Accordingly, the government has introduced a scheme to allow normal-security licences to be converted to high-security status in return for a reduction in volumetric allocation and a higher charge per megalitre. The precise terms of the trade-off differ across river valleys and areas, but the formula is based on the maintenance of existing supply reliability to the remaining normal-security licence holders. The conversion of licences from normal to high security in return for reduced volume entitlement has already begun on the Lachlan River. The formula in use permits the exchange of 1000 megalitres of normal security for 700 megalitres of high security.

In the past, high-security irrigation licences have typically been available only for permanent plantings, such as fruit orchards. However, the conversion scheme is not limited only to those who wish to establish permanent plantings. For example, one irrigator on the Lachlan River has a contract to supply vegetables to Edgells. To ensure he can satisfy the terms of that contract, he has opted to convert to high security for a smaller volume. Similarly, another irrigator has employed a number of staff whom he does not wish to lose during some future dry period and has also chosen to convert his entitlement to avoid possible retrenchments.

The NSW government is not currently considering the introduction of intermediate licence steps between high and normal security. Yet this would be worth contemplating at some future stage. A hierarchy of security levels on licences, developed through conversions of supply for security, could increase flexibility in water allocation, potentially allowing for the additional fine tuning necessary for water to move to its highest-value use. Ultimately, however, the decision to set in place such a

hierarchy would depend on whether the savings so gained could offset the costs involved in administering licence conversions on this scale.

Overdrawing. In addition to licence conversions, irrigators can also temporarily alter their reliability of supply by taking out what are, in effect, water loans. This is done through an 'overdrawing' scheme whereby the irrigator is permitted to borrow from his water allocation for the following year. This is often done if, for example, an irrigator wishes to plant a big crop at the beginning of the year in anticipation of a predicted good market for that crop, yet finds his annual expected water allocation to be inadequate. The irrigator can then temporarily make up this shortfall by taking an advance on his water allocation for the following year. This gives the irrigator the flexibility to maximise the value of his output by drawing on his future allocations in years when returns from irrigated agriculture are likely to be particularly high.

Overdrawing can prove a particular bonus for irrigators if there are heavy rains leading to surplus flow after a water loan has been taken out. If this occurs, the borrowing irrigator may not receive a reduced allocation in the following year, but may instead be able to receive his full entitlement (assuming all other entitlements can be adequately met).

Both licence conversions and overdrawing are examples of government introducing flexibility into the water market in order to increase efficiency. Whereas the former increases the water user's control over the probability of receiving his entitlement, the latter allows for a type of 'water intermediation', which improves the likelihood that water will be used most when the value of its use is highest.

Chapter 5

Restrictions on Transferability

The introduction of tradability in water rights was an inevitable response to scarcity. But it would be wrong to assume that this has been the only factor guiding the development of property rights in water. Other considerations, both economic and technical, have also had an influence, and some of these have had the result of placing greater restrictions on water transfers.

This dampening of the free play of water markets is a feature particularly of the irrigation areas. To begin with, because of opposition to permanent transfers, such transfers are still available in only some of the areas and districts (though permanent transfers are available in all regulated river valleys). Furthermore, irrigator boards in the areas have set residual water entitlements for landholdings that are not eligible for transfer. For example, this minimum residual requirement in the Murrumbidgee irrigation area is currently four megalitres per hectare.

In addition, water tradability in both irrigation areas and districts and regulated river valleys is constrained by zonal restrictions on water transfers. These restrictions map out zones beyond which transfers are not permitted. All of these restrictions on transfers have one common feature: they attempt to ensure that water is not transferred away from the locality of its original issue. That is, they impose geographic constraints on tradability.

Technical Constraints

The technology associated with the supply and transfer of water has played some role in imposing these restrictions. In particular, zonal restrictions on water transfers in part reflect technological constraints on the movement of water.

A major factor here is what is known as 'transmission loss': the loss of water that occurs through seepage and evaporation as water moves through rivers and channels. (Water Resources currently estimates that transmission losses in New South Wales river systems average in the order of 20 per cent.) Obviously, the greater the distance water needs to travel, the greater is the transmission loss. Similarly, the lower the river gradient, the slower the flow, the longer the transit period and the greater the transmission loss. By limiting the distance over which transfers occur, particularly on rivers with low gradients, zonal restrictions may also limit water wastage through transmission loss.

Transfer zones are also often made necessary by capacity limitations in storage works or in the waterways themselves. Gunidgera and Pian

Creeks, which are fed from the Namoi River near Wee Waa, provide a good example of the impact of both types of capacity limits. Although water users on these creeks are free to transfer water among themselves, or to transfer water out on to the Namoi River, transfers from the Namoi River on to these creeks are not permitted, for two reasons. First, the weir feeding off the Namoi on to the creeks has a limited capacity and would not be able to cope with any additional water. Second, the creeks themselves have limited capacity and additional diversion of water on to the creeks through transfers could lead to flooding.

Finally, transfer zones may also increase the administrative ease with which minimum in-stream flows are maintained. In short, if the government is required to ensure that some minimum in-stream flow is met, it becomes a relatively easier matter if water transfers are geographically bounded. Thus a set allocated flow will always be retained with a particular river zone, irrespective of the number of water transfers that occur.

Economic and Political Constraints

Physical limitations on the technology available for moving water have probably caused fewer restrictions on transfers than economic and political considerations. A major concern here has been the damage to local economic conditions that the large-scale movement of water away from particular localities could bring about. In this context, transfer restrictions may be considered as mechanisms that attempt to contain water within local economies.

It is possible, of course, that a large-scale movement of water away from a region could have implications for the local economy. It may cause a downturn in local irrigation-based farm activity, which may lead to a decline in the value of local agricultural output and hence also to a decline in local industries supplying local farm inputs and processing farm produce. It has also been argued that big water movements may depress the local economy through their impact on local-government revenue. Local-government rates are levied on the basis of land values. The sale of water entitlements out of the region may lead to a depreciation in the value of the attached property and a subsequent contraction in local-government revenue. This shrinkage in revenue would then, it is argued, aggravate the deterioration in local economic conditions. The importance of this concern to local governments was evident in their initial lobbying of Water Resources for transfer restriction zones to fall along shire boundaries. (No comment is made here about the appropriateness of local governments taxing both land and water because of opposition to permanent transfers.)

Of course, the separation of water rights from landholdings and the subsequent transfer of water rights does not, of itself, have any effect on

underlying rural land values. But it does clarify rural land values through separating land values from water values. Net transfers of water out of a district might possibly result in a reduction in economic activity within that district, leading to some reduction in commercial land values. Yet although such factors may operate to some extent, it is by no means certain that a large-scale shift in water would lead to local economic decline. A shift of water may result in a move to drier farming, which could offset the decline in irrigated farming, particularly if irrigation water had been put to low-value use. Further, since the former owners of water will have been paid a price equivalent to or greater than the net present value of the water they sell, the price they receive should approximately equal the value they would have received from the future use of that water. In this sense, the wealth of the region should not decline, and could even increase as local capital is freed for higher-value uses.

So even when considered from a regional or local perspective, arguments for restricting water transfers on grounds of protecting local economies are of dubious standing. Further, as is typical of controls that inhibit the operation of markets, any restriction on water transfers designed to protect local economies will involve a trade-off between the distribution and the maximisation of wealth. That is, while constraints on tradability protect local economies, they also prevent water moving to its highest-value use. They thus contradict the imperative to deal with water scarcity by maximising efficiency.

The trade-offs involved in deciding whether or not to restrict transfers geographically are evident from the gains from shifts in water that have occurred within transfer zones on regulated rivers. Though water cannot normally be transferred beyond these zones, the availability of permanent transfers and the lack of a non-transferable residual water entitlement mean that water can be freely transferred within these zones.

What is being observed in many of the regulated river zones is a shift of water away from the hilly upper-valley reaches to flatter downstream areas that better suit profitable, large-scale irrigation agriculture. The Namoi river valley provides us with an example of this shift. While lucrative cotton crops cannot be successfully cultivated in the upper reaches of the Namoi near Gunnedah, they can be grown profitably in the lower and flatter reaches down-valley. Hence the tendency for water entitlements in the upper valley to be purchased by cotton growers downstream.

Advocates of restrictions on transfers might use movements in water such as these to defend their position, arguing that unrestricted transfers impoverish less productive regions. Yet this should, in fact, be viewed as a vindication of the transferability of water: it shows the resource moving to a higher-value use (in this case, the irrigation of cotton crops). And it

shows that when conditions of scarcity prevail, fully tradable property rights in water will maximise efficiency, albeit at the price of a possible shift in patterns of local economic activity.

The corollary of this, of course, is that unnecessary restrictions on the movement of water between areas must be compromising total State efficiency. This raises the prospect of not only removing restrictions that prevent the transfer of water rights within river valleys, but also of allowing for the transfer of water rights between river valleys.

One such inter-river valley transfer has already occurred and may well offer a pointer for the future. This singular example occurred in 1992 after extensive negotiation and a deal of controversy. It entailed the 'de-allocation' of the 10 000 megalitres of water attached to a property on the Murrimbidgee River and the transfer and subsequent re-allocation of that water right to a cotton farm on the lower Darling River. (Of course, the Murrimbidgee River allocation was not physically transferred to the lower Darling, as such a transfer would be physically impossible. Only the property right to an allocation of water was transferred.)

As could be expected, the transfer was opposed by the Murrimbidgee River Management Board, which tended to take the view that water allocations available from the Murrimbidgee should remain with the Murrimbidgee and should not be considered a State resource capable of re-allocation to other areas of the State.

However, there were a number of compelling reasons to allow the transfer to proceed. First, it offered a net environmental benefit to the State by increasing in-stream flow in the Murrimbidgee and Murray Rivers, though at the price of some reduction in flow in the lower Darling. However, the latter was to be offset to an extent through the release of additional reservoir water to the Darling. Second, it offered net economic gains for the State, promising employment-generating investment and an addition to State product of more than $2 million. Consequently, Water Resources eventually prevailed on the opposing local Murrimbidgee interests to permit the transfer to proceed, albeit only on the basis of a five-year lease. The prospect of inter-river valley transfers raises the question of inter-State transfers. It could well be argued that national efficiency could be enhanced if, say, South Australia were able to buy additional water from New South Wales and Victoria.

Increasing Farm Incomes

In a sense, then, New South Wales has been realising only some of the efficiency gains available from water trade when conditions of scarcity prevail. Yet there is overwhelming evidence to suggest that we should press on with the process and continue to free up water markets. This evidence is provided by figures for increases in farm income that the

existing system of water transfers has already given to New South Wales. Such increases can be calculated approximately by identifying the dominant crop grown in a region, estimating how much of this crop can be grown per megalitre, and then calculating the dollar value of that crop per megalitre. Then all water transfers are added for that region that occur late in the year (late-year transfers are taken to give an estimate of the annual net transfer of water since most transfers occur late in the year). This volume of transfers is then multiplied by the dollar per megalitre values based on predominant crop types to give an approximate figure for change in farm income through water transfers.

It should be emphasised that the measurement of increases in farm income from water transfers is necessarily rough, for two reasons. First, it is a gross revenue measure, as the costs of non-water inputs are not factored into the figures. Second, it assumes that the water transferred has zero value to the seller: that is, by selling water, the seller does not forgo farm income that might otherwise have been derived if the seller had used that water as an input for farm production. In other words, it is assumed the water transferred is excess to the requirements of the seller in his capacity as a profit-maximising farmer. Both of these factors may therefore serve to overestimate the boost to farm income derived from water transfers.

Boosted farm income is also necessarily an average yield measure. Water transfers may often mean the difference between crop failure and success. However, the figures do not capture the impact of water transfers on existing plantings. In this sense, the figures may underestimate boosted farm income.

Despite these weaknesses, the figures do provide a useful indication of the additional income that can be generated from water transfers. Specifically, for the seven years since the introduction of water transfers in 1983/84, rural income in this New South Wales has been boosted by some $42.5 million. Significantly, this benefit was achieved at almost no cost to the government, as water trading has been based on private transactions.

To give some specific annual figures: In 1988/89 it was estimated that transfers of irrigation-water entitlements increased rural income by $5.6 million. This comprised 280 transfers of 85 000 megalitres in total. This was despite the alleviation of scarcity by a relatively wet season. In 1990/91 the addition to rural income as a consequence of water transfers had nearly doubled to some $10 million. This comprised 437 transfers of a total of some 120 000 megalitres. However, even more interesting was the drought year of 1987/88, in which 687 transfers occurred, amounting to approximately 340 000 megalitres. These transfers lifted rural income for that year by an incredible $17 million. If benefits of this scale can be obtained by a system of water transfers circumscribed by regional barriers,

the benefits that would flow from the redefinition of water property rights to allow the free transfer of water between regions (subject to technological and environmental constraints on transfers) would be greater still.

Individuals and groups campaigning against increased transferability have been motivated by often misplaced anxieties over the likelihood of water transfers diminishing their wealth. It has been suggested, for example, that some of the heavier irrigators in the irrigation areas fear that government may wish to manipulate water markets to move water away from the areas because of the impact of heavy irrigation on salinity and waterlogging problems. As well, some irrigators allegedly fear that unrestricted water transfers could undermine their market dominance. A shift of water away from the areas would allow types of agriculture now practised only within the areas to be practised elsewhere. For example, until recently rice was grown only within irrigation areas and districts, mainly because of the large quantities of water required. However, rice is now being grown in regulated river valleys; and this trend is likely to continue if water is transferred away from the areas.

Such fears are understandable. However, the responsibility of government is to manage the State's resources in the interests of the public as a whole. And if the wealth of the State as a whole can be increased by creating more efficient markets, then reform would be justified, even though it may impose losses on certain sectional interests.

Chapter 6

Developing Market Sophistication

Despite constraints on the tradability of rights, water markets in New South Wales have developed a considerable degree of sophistication.

Arbitrage and Water Futures

Arbitrage trade has developed in water rights, with some users now speculating on the value of water entitlements. This has been made possible by variations in the market price for water caused by vagaries of weather. Water prices tend to increase in dry periods as scarcity worsens, and to decrease in wetter and more plentiful periods. Savings can therefore be made if water entitlements are purchased during wetter years; and farmers have been doing precisely that. Entitlements purchased in wet years are often taken as insurance against dry years and poor supply reliability. But speculators are also buying up water entitlements at lower prices during wetter periods in the hope of selling those entitlements for gain at a subsequent and drier date.

In addition to arbitrage trade, a futures-style trade in water has also been developed by water users, primarily to guard against inadequate supply reliability. For instance, irrigators on the Namoi/Gwydir are contracting with other water-licence holders to supply them with water in dry periods, and are agreeing on supply prices in advance. In effect, the irrigator takes out an option for the purchase of water at a future date. As well, some properties on the Namoi River will evidently no longer be productive in a few years because of soil exhaustion. Some of the irrigators farming these affected properties have arranged to sell their water entitlements to other water users at a pre-arranged future date in anticipation of soil exhaustion.

This sophisticated arbitrage and futures-style trading of water rights, though sometimes speculative, is nevertheless evidence of a healthy market. It deepens the market and increases market efficiency through increasing the volume of transactions. And it enhances the efficiency of resource use by permitting those with superior information on future market conditions to take a dominant market position and so increase the probability that water will be allocated to its highest-value use. It is to be hoped that trading of this kind increases as unnecessary restrictions on the free transfer of water are progressively removed.

Water Prices and Transitional Gains

The move to a property-rights and market-based allocation of water in rural New South Wales has not proceeded without controversy. Particularly

controversial has been the one-off capital gain some water-entitlement holders have been able to make on the sale at market prices of water rights acquired under government-financed and subsidised projects.

Prior to the embargoes, water-licence entitlements were obtained by landholders at a nominal fee. Fees were typically not more than $1000 and were based on the area of land authorised to be irrigated. For example, the cost of the standard 162 ha. (400 acre) licence with a 972 megalitre water entitlement before the 1981 embargo was $854. Increments in the licence fee charged declined as the area authorised to be irrigated increased.

Yet since the embargoes were set in place, the value of a water licence has risen steeply. The water licence has become a commodity in demand, especially for potential new entrants to irrigated agriculture. This, in turn, has allowed some one-off windfall capital gains to be made on water entitlements acquired originally at nominal price. Transitional gain has been made either through capitalising the market value of nominally acquired water entitlements into land values at land sales, or through the transfer sale at market price of nominally acquired water entitlements.

As an indication of some of the prices being paid for water entitlements and of the potential scale of appreciation and capital gain involved, an entitlement of 1000 megalitres in a cotton-growing region on the Gwydir River was sold in 1989 for $300 000, or $300 per megalitre. This price appears extraordinary when compared to its original nominal value, but can be better comprehended in the light of the following points. First, cotton is currently a very lucrative crop with a buoyant export price. Second, as mentioned previously, the reliability of supply on the Gwydir River is only about 45 per cent. As a particularly scarce resource, an additional premium is set on the value of water on the Gwydir. In fact, the Gwydir's poor supply-reliability level and the dominance of cotton in the valley are reflected in higher transfer prices throughout the Gwydir generally; it is not uncommon for standard 972 megalitre licences to be sold for more than $200 000 or $200 per megalitre.

It may appear paradoxical that poor supply reliability on the Gwydir should increase the value of water rights. Certainly, it can be argued that the more reliable the water entitlement, the greater the value of the right. However, supply reliability is also an indicator of average scarcity. For a fully allocated resource, the greater its scarcity, the lower its reliability of supply and the greater its value. Supply reliability is therefore an average characteristic of water entitlements in a river valley, in addition to describing individual entitlements. Accordingly, it should not be surprising that the relatively scarce waters of the Gwydir should fetch such high prices when traded as an input to lucrative cotton production. Water prices can also be as high as $200 per megalitre on the Lower Darling below the Menindee Storage, particularly

when the entitlement is less than 400 megalitres and the licence is attached to a small holding suitable for high-value horticulture.

Transfer prices in other areas are typically not so high. For example, in the Peel River Valley licences are generally used to irrigate fodder and pasture crops as opposed to high-income crops such as cotton. Accordingly, licence demand tends to be lower and this is reflected in lower transfer prices: water in the Peel Valley is typically being sold for between $50 and $60 per megalitre.

As well as varying across river valleys, prices can vary within a river valley. For example, the value of an upstream licence where there is poor flow could be lower than a downstream licence attached to a similar land type for which downstream tributaries ensure enhanced supply reliability. In this sense, the upstream and downstream licences describe different products, with the downstream licence offering its buyer additional water security. Similarly, if a water entitlement is sold along with the attached land, then the additional capital gain that water entitlement nets for the vendor will, in part, be dependent upon the suitability of the attached land for irrigation. However, the value of a water entitlement will be influenced by the characteristics of the attached land only when there are restrictions on the separate transfer of water. Of course, licence prices within a valley will also vary in accordance with licence-security levels, with the higher supply-reliability characteristics of high-security licences attracting a per megalitre premium.

To date, the government has chosen not to take a share in the gains being made within the water-transfer markets. Legal advice indicates that some of the transitional gains being made are effectively capital gains and would be subject to Commonwealth capital-gains taxation. However, capital-gains tax applies only to gains on water entitlements acquired after 20 September 1985. Of course, the State could attempt to earn revenue from capital gains by imposing a stamp duty on water transfers. This would be consistent with New South Wales government's tax policy. However, the merits of imposing a stamp duty or any other mechanism designed to earn the State a share in windfall gains should be assessed in terms of its likely impact on the water-transfer market. This sort of interference may well discourage water-entitlement holders from entering into transactions, thereby diminishing the scale of efficiency gains derived from the water-transfer market. In this respect, it might be more appropriate to consider the positive flow-on benefits that water transfers offer to the State as a whole, rather than penalising windfall capital gains made on those transfers.

In any case, it should be remembered that the capital gains now being made are necessarily one-off. Water users who have bought into the water market after the imposition of the embargoes would have paid the full

market price for their water entitlements and do not stand to make windfall capital gain on subsequent sales. From the government's perspective, it then becomes a case of accepting a one-off capital loss (as a result of policy mistakes in the past), in return for continuing future improvements in efficiency.

New Licences and 'Water Auctioning'

Windfall capital gains on water transfers have been made primarily as a result of past government policy to subsidise the rural sector. This led to massive government-subsidised infrastructure outlays on water regulation and the supply of water to users at highly subsidised prices. Of course, this involved allocating water through central agencies rather than via the market.

This state of affairs should not be allowed to recur. If new water licences are to be made available, then the price should reflect both the capital cost of delivering that water and the opportunity cost of alternative uses. To this end, the New South Wales government is likely to follow the lead given by Victoria and Queensland and auction off any future new water licences. For instance, Victoria now publicly auctions new water entitlements by setting a per megalitre reserve price and then calling for the highest bidder for entitlements of varying megalitre sizes. In a 1988 auction of water entitlements on the Loddon River, the Victorian government set a reserve price of $100 per megalitre. The highest bid received was $773 per megalitre for an eight-megalitre licence, while the average per megalitre price was $239. This particular auction alone netted some $477 000 in revenue for the Victorian State; it is estimated total revenue earned for Victoria through water auctions is now in excess of $2 million.

Despite the obvious logic of the auctioning system, its introduction in Victoria led to widespread protests from irrigators (though opposition there appears to have now diminished). It is probable that a move to auctioning in New South Wales would bring about similar opposition from irrigators, but it is unlikely that future governments there would bend to such protests.

In terms of the potential issue of new irrigator licences, two new sources of regulated water have recently come on line since the 1981 licence embargo. The first of these was Split Rock Dam near Tamworth, which was completed in early 1988 at a cost of some $53 million. Water from this dam has been primarily used to increase the security of supply for existing water-licence holders. New licences have not been issued, as the embargo on the issue of licences in the receiving river valley has not been lifted. Split Rock Dam has therefore largely been a missed opportunity. Not only were new licences not made available for auction, but the increase in supply security has been given at zero cost to the

existing licensees, as no attempt has been made to recoup that $53 million capital outlay through higher water charges. This failure to recoup capital costs on Split Rock Dam reflects the continuation of a government policy that classifies storage works as national assets and so prevents their capital costs being charged to a particular group of users.

The second new regulated water source was made available following a threefold enlargement of Glenbawn Dam in the Hunter Valley. This enlargement was ordered following plans to establish an additional electricity generating station and aluminium smelter, both of which would have required large quantities of water. As it has turned out, neither of these plans has come to fruition, and there is now significant excess water in the dam.

Unfortunately, agricultural demands have not been sufficient to take up this supply slack, for two reasons. First, there are very few large-scale irrigators in the Hunter Valley, and fewer still who irrigate high-earning cash crops. Second, as irrigated agriculture has not expanded much, there has been little demand for the issue of new licences and the lifting of the valley's licence embargo. All that has really happened since the enlargement is that water-supply reliability has been hugely increased for existing water users, free of charge. The only instance in which new water licences have become available in New South Wales since the 1981 embargo has been on Windermere Dam to the north-east of Mudgee. In 1990/91, Water Resources found that more water was available for allocation from the Windermere-Burrendong system than had previously been thought. The department has subsequently offered 5000 megalitres of water from the dam for sale by tender.

It is to be hoped the Pindari Dam enlargement joint venture with irrigators will prove more satisfactory, at least in terms of recouping capital costs. However, the project is designed to increase reliability of supply only for existing licence holders. It is not intended to issue new water licences once the enlargement is completed. Under the terms of the Pindari joint venture, the government will meet initial capital costs and then recoup half of these costs through an agreed increase in water prices for existing licence holders. The cost of the project is $76 million and irrigators will meet $36.5 million of this over a 17-year period through increased user charges.

Although new licences have not been issued where additional regulated water has recently been made available — either through lack of demand (Glenbawn Dam) or because the issue of licences has been prevented by continued embargo (Split Rock Dam and potentially Pindari Dam) — they may become available for issue in the future through improved water management by the Department of Water Resources. In the past, Water Resources has had to run its regulated water service with

a certain amount of reserves because of uncertainty over exactly how much water was available and what the likely demands for that water were going to be. However, improved techniques are allowing Water Resources to reduce this uncertainty and cut away some of this fat. This means there may soon be additional water available for issue as new water licences.

If this does turn out to be the case, water users must of course be prepared to bid for the new licences at auction prices that fully reflect the capital costs associated with water supply. This movement to full recovery of capital costs will be inevitable in the future as resources become increasingly scarce; and it can be expected to occur regardless of the political persuasion of the government of the day.

Prospects for the Market Allocation of Groundwater

This study deals with the development of markets for the allocation of surface water. However, it is worth mentioning in passing that the market-based allocative mechanisms being used to allocate surface water in rural New South Wales might be usefully extended to the allocation of rights in groundwater.

Just as the development of surface-water markets has been largely contingent upon conditions of resource scarcity, similar conditions are now applying to the groundwater resource, and Water Resources is now considering the appropriateness of market solutions to it. As with surface water, the groundwater resource is being overused in both its quantitative and qualitative dimensions. For example, in northern river valleys such as the Lower Namoi and Mooki, the groundwater resource has been fully allocated. Yet in the southern river valleys and the Murray Basin, groundwater has tended to be under-utilised relative to surface water. Irrigation and land-management practice have subsequent resulted in a rising water table, creating salinity and other pollution problems in groundwater aquifers.

Currently, groundwater is allocated by volume and attaches to properties that lie over the resource. Some temporary groundwater transfers are permitted among properties that lie within a common groundwater management area and hydro-geological zone. The introduction of permanent transfers is also being considered.

In addition to transfers of groundwater entitlements within a particular aquifer, opportunities may also exist for transferring rights to groundwater across aquifers where these occur in strata. This would be conceptually similar to transferring surface-water entitlements between river systems. If groundwater rights are to be transferred between aquifers, it will be necessary to ensure that the environmental integrity of the aquifers is maintained and that the supply of groundwater to existing entitlements on those aquifers is not affected.

Chapter 7

Water Quality and the Environment

We have examined how water markets operate to allocate water diverted from rivers. Some attention now needs to be paid to the water that remains in the rivers: the in-stream flow. It is essential that some level of in-stream flow be maintained if riverine ecosystems are to be preserved. Some in-stream flow is also necessary if rivers are to remain navigable, recreational needs met and effluent dispersed.

The Department of Water Resources requires that a certain level of in-stream flow is maintained at the 'bottom end' of rivers for environmental reasons and to ensure that recreational and commercial in-stream needs are met. Unfortunately, uncertainty over the ecologically appropriate level of in-stream flow has created 'fuzzy borders'. This has sometimes meant that in-stream needs have been compromised by private water-diversion rights. Water Resources is currently attempting to tie down in-stream flow with greater certainty and is undertaking extensive scientific surveys to determine the environmental base-line for in-stream flows in light of competing water uses.

Environmental Allocations and the Macquarie Marshes

The difficulties associated with a failure to definitively tie down in-stream allocation are illustrated by the history of an environmental allocation of water for the Macquarie Marshes (the wetlands adjacent to the Macquarie River).

The Burrendong Dam was constructed on the Macquarie River upstream from the Marshes in the 1950s. At that time it was proposed to reserve some 50 000 megalitres of water as a minimum value for 'normal' seasons to ensure regular flooding of the Marshes (essential for the survival and regeneration of the flora and fauna). Although 50 000 megalitres was insufficient to generate flooding, it was envisaged the water could be used during wet periods naturally to top-up flooding. However, once the dam was constructed, it was decided that, in view of demands for water from developing irrigation agriculture, only 18 000 megalitres of water should be allocated to the Marshes. This was a clear case of a 'fuzzy' allocation of in-stream flow resulting in the subversion of flow rights by diversion rights.

Additional pressure was placed on the ecosystems of the Marshes in the 1960s, when it was decided to construct works at the northern (downstream) end of the Marshes to ensure that water reached irrigators and was not lost amongst the numerous tributaries that feed the Marshes. This involved building a weir and channel to by-pass Marsh tributaries. In the late 1970s it was decided, for the same reason, that further by-pass

works were required in the southern (upstream) end of the Marshes. This additional encroachment on in-stream flow for the Marshes met stiff opposition from the now more vocal environmental groups. It was eventually determined that major works would not proceed in the southern reaches of the Marshes, but that Water Resources should agree on a management plan with the National Parks and Wildlife Service that would allow for the construction of some minor by-pass works.

The sticking point in negotiations on a management plan was, predictably, the amount of water that was to be reserved for the Marshes. Conflict persisted over whether the allocation for environmental release should be 18 000 or 50 000 megalitres, with irrigators lobbying for retention of the smaller allocation. Further, some environmentalists had criticised the 50 000 megalitre allocation as inadequate and were calling for an even larger allocation. Clearly, the rights allocated to in-stream flow for the Marshes still had 'fuzzy borders'. The major problem was that ecological knowledge of the Marshes was insufficient to determine the volume of water necessary to ensure biological regeneration. And, of course, downstream irrigators had a strong incentive to resist any increase in the environmental allocation, since this would reduce the reliability of their supply.

The lesson from the Macquarie Marshes is that in-stream rights must be clearly defined and allocated in a way that does not permit encroachment by other users or subsequent reallocation through the political process. Indeed, the various in-stream uses — water flow, navigation, recreation, conservation, etc. — need to be distinguished and, preferably, allocated separately. It may be, for example, that certain environmental uses will require allocation on a diversionary basis and not in-stream.

Most such in-stream rights probably cannot be allocated to private users, and must remain a function of the agency responsible for running the rivers. From one perspective, this might be seen as a case of market failure. Yet it might also be viewed as simply one of the preconditions for a real-world market in private water rights.

But it is not clear that some of these environmental uses could not be allocated to other users. Nothing would tidy up the 'fuzzy borders' of these environmental rights more quickly than allocating them to an environmental agency within government or to a private environmental group. Such a regime would create a trustee who could, as it were, speak for these environmental resources, and if necessary enforce them at law. It would also permit environmentally sensitive leasing of the allocation in order to generate funds for other environmental works. This view has been expressed by Mr Peter Millington as Director of the Department of Water Resources:

> If the National Parks and Wildlife Service, or another body established to manage the Marshes, were permitted to transfer the

> allocation, the total volume of water could provide for about $5 million worth of cotton production at current prices. To allow the permanent transfer of this special purpose allocation would obviously be contradictory to the reason for granting it. However, if temporary transfer were permitted, the funds obtained from trading could either be put back into managing the marshes or used to acquire allocations for similar purposes in other river valleys. (Millington, 1991:22)

The other lesson from the Macquarie Marshes is that environmental uses should be fully identified before water rights are issued by the government to private users, so that, from the outset, there is no misunderstanding as to the boundaries of the various rights.

Where rights have already been fully allocated and government decides that it needs additional water for new agricultural or environmental purposes, then it must create surplus capacity through dam expansion or improved efficiency of the system. It is clearly inequitable, in the absence of such options, to appropriate private property — in this case, entitlements to divert water from the rivers — without paying full compensation.

Water Quality: An Emerging Issue

Water-quality considerations are playing an increasing role in the allocation of water resources. As we have mentioned, water users are now paying for water-quality functions carried out by the Department of Water Resources through the delivery service charge. At present, the Department outlays some $15 million a year in recurrent expenditure on water-quality activities. These comprise the monitoring of water quality at 700 gauging points along rivers and a further 70 such stations in storage works, not to mention some 3000 groundwater monitoring bores. The major problems being targeted at present are algal growth (or eutrophication) and toxic pollution, particularly that caused by pesticides. Follow-up action to problems such as these has included advising affected communities, revising licensing conditions, and aerating and flushing dams and rivers.

Water Resources' involvement in water quality, and water users' payment for water-quality services, are once again the results of a changing water-rights regime. Until recently, property rights in water failed to reflect water-quality considerations. Property rights were defined on the assumption that water quality would always be acceptable, irrespective of the level of water use. No one had foreseen the need to ensure that water-property rights should incorporate the dimension of water quality. Yet as human activity in catchment areas and along river systems has increased, the level of water quality has been eroded, increasing the scarcity of this dimension of the water resource. Water rights have then needed to change to reflect this

scarcity by ensuring water-quality protection. This change in water rights has been made possible through water pricing. The right to use the resource is now so defined as to incorporate at least some of the costs of monitoring and protecting water quality: costs that water users are themselves imposing on river systems. Again, as with the shift to tradable water rights, the demand for the redefining of water rights to incorporate the water-quality dimension has come from water users themselves.

As the water quality dimension of the resource continues to become more scarce, government will need to modify the way in which rights are defined to ensure full user charges for water-quality costs and, in time no doubt, transferability of entitlements on the basis of specified water quality.

Of course, water-quality problems in river systems are not attributable solely to the activities of those who own water rights. For example, eutrophication is typically caused by the transmission to river systems of nutrients from a variety of agricultural, industrial and urban sources not necessarily linked to water use and often physically distant from waterways. It would therefore be inappropriate to charge irrigators and other water users with all the costs associated with water-quality monitoring and control. This suggests that if water quality is to be efficiently protected, modifying water rights to ensure that users more fully meet the water-quality costs associated with their use of the resource will not be sufficient in itself. The perspective from which the problem is viewed should be broadened to incorporate all land-use activities that erode water quality.

Government is already moving towards a more inclusive capture of water-quality costs through Total Catchment Management (TCM). This is a strategy for community involvement in natural-resource management on the basis of river valleys or catchment areas and includes management of water quality. Under TCM, all groups — local government, landholders, community groups — share some responsibility for natural-resource problems such as water quality. This can involve the establishment of trusts, which may set rates for specific purposes. The Hunter Valley Catchment Management Trust, for example, was established primarily to deal with flooding and river siltation problems. Similar arrangements for recouping the costs of water-quality monitoring and enforcement on inland rivers may, in the future, allow for more equitable contributions to water-quality costs across catchment areas.

TCM is, in effect, an embryonic property-rights system, though one that attempts to define rights on a catchment-area basis rather than on the basis of licensed water users alone. Although its complete definition may take many years, and may ultimately not be fully possible, TCM remains a rational attempt at clearly allocating decision-making entitlements to our natural resources on a geographic basis.

Salinity and the Development of a Market for River Discharge Rights

The contributions made by landholders under TCM to meet some of the costs of the environmental externalities generated by their in-catchment activities is a significant step towards a better definition of property rights over water resources. However, it must be viewed as an essentially reactive response to diminishing water quality that does not address the need to stabilise or reduce existing or future discharges to river systems.

If we are to curb and control discharge levels at their source, we need to consider allocating rights to discharge through the development of a market in tradable discharge rights. This would be similar to the markets in tradable emission permits that are now being developed in the United States and would involve allocating rights to discharge into river systems within a catchment up to a certain limit. The allocation could be made either through auction or on the basis of existing use rights. Holders of discharge rights would then be free to trade in those rights. Those who wished to increase their discharge levels in excess of their original discharge right would be required to purchase additional rights from others within the catchment who were prepared to reduce their discharge levels below their existing entitlement. If it was the government's wish to affect a reduction in aggregate discharge levels, discharge rights could be retired from the catchment through their purchase by government as individual holders of discharge rights reduced their discharge levels.

Such a market would have the particular advantages of: signalling an upper (and potentially diminishing) limit for discharges; providing a financial incentive to individual rights holders to reduce discharges; and allowing discharge reductions to be made at least cost. Clearly, those with the greatest incentive to reduce their discharge levels would be those able to affect a reduction most cheaply.

Although such a market would be conceptually separate from the existing rural water markets, it would be integral to the continued operation of those markets by setting limits — and potentially reducing limits — on the extent to which the quality dimension of the resource can be used. This would work against the potential diminution of the value of tradable water rights in terms of water quality and any subsequent reduction in the incentive to trade those rights that that diminution may otherwise have caused.

Such a market in discharge rights has yet to be developed, though increasing pressure on water quality may hasten its formation. However, a system of discharge rights has been developed at an inter-governmental level for salinity discharges into the Murray-Darling river system. The system has been developed under the auspices of the Murray-Darling Basin Council (comprising New South Wales, Victorian, South Australian

and Commonwealth Ministers) through the Council's Salinity and Drainage Strategy. This strategy sets goals for the reduction of saline discharges to the river system through the allocation to participating governments of salinity-discharge entitlements. These entitlements take the form of 'salt credits' and are issued annually over and above a residual salinity level based upon existing activities. Proposed new activities that threaten to increase salinity levels are assessed as a debit against a government's salt credits. It is left to the discretion of individual governments to allocate the credits to new activities. Once the salt credits have been exhausted, no new salinity increasing activities are permitted. However, governments can earn additional salt credits through undertaking salt-removal works.

The salt-credit system currently operates at governmental level, but it would appear possible to extend the system to landholders and water users who would be able to trade in those credits within a market for salinity discharges. This market could be linked directly to water markets. It should be noted that any reduction of in-stream flows through off-river water allocation tends to increase river salinity. This suggests that it could be made necessary to purchase a salt credit on the salinity-discharge market as a precondition to purchasing new or additional water in the water markets.

Chapter 8

Conclusion

It may, perhaps, seem paradoxical that environmental considerations should have played such a major role in stimulating microeconomic reform of a natural resource such as water. But then, since economics is a discipline premised upon scarcity and since environmentalism is simply about a particular kind of scarcity, perhaps this should not come as a surprise after all.

The evolution of the market for surface water in rural New South Wales is an important case study in the development of a tradable-rights regime in a non-stationary natural resource. It provides strong support for the interest that Australian policy analysts have exhibited over the past few years in the application of economic instruments to natural-resource planning. Moreover, the fact that most of the policy changes necessary for the development of this market took place under a Labor administration suggests that there may well be bipartisan support for such initiatives. Policymakers can be confident of being able to explore the use of tradable property rights in natural resources without being criticised for pursuing policy instruments that are acceptable only to one side of the political fence.

None of this is to say that market solutions are appropriate for every natural-resource problem. As we noted at the outset, there are numerous situations in which property rights in a resource simply cannot be defined or economically enforced, at least with current technology. And with most resources there would seem to be a period of time when traditional 'command and control' solutions, however crude, are economically more defensible than a highly ramified property-rights system.

However, this particular case study does suggest that market approaches offer solutions to some of the difficulties of natural-resource planning and that, in some cases, bureaucratic decision-makers can improve the quality of the information at their disposal through the introduction of tradable property-rights regimes.

The water market that is evolving in New South Wales is by no means complete, nor has its development been free of bureaucratic error and political opportunism by irrigators. Design flaws, such as those made at the time of the 1981 embargo which permitted licence holders to make massive windfall gains, are difficult to excuse in retrospect. But it does need to be appreciated that the water market evolved rather than being the product of a deliberate policy consciously adopted by the government in 1981.

A third stage of water reform is under consideration by the New South

Wales government at the time of publication; and although this will further define the decision-making entitlements in relation to New South Wales rural water, it will by no means formalise the property rights that are still emerging.

While there are dangers (and costs) in this incremental approach to market design, the politics of water in country New South Wales and, in early stages, the poor understanding of property rights within the New South Wales government in general and Water Resources in particular, probably mean that a water market could not have developed in any other way.

Above all else, policymakers need to demystify the academic literature, to strip away the jargon and explain to politicians, public servants and private stakeholders the advantages and the limitations of market solutions to natural-resource allocation. In Australia, that process has at least begun.

References and Bibliography

Anderson, T. (1982), 'The New Resource Economics: Old Ideas and New Applications', *American Journal of Agricultural Economics* 64: 928–34.

——— (1983), *Water Crisis: Ending the Policy Drought*, Cato Institute, Washington, D.C.

——— (ed.) (1983), *Water Rights*, Pacific Institute for Public Policy Research, San Francisco.

——— (1991), *The Market Process and Environmental Amenities*, Centre for Independent Studies, Sydney.

——— & P. Hill (1975), 'The Evolution of Property Rights: A Study of the American West', *The Journal of Law and Economics* 18: 163–79.

——— (1979), 'An American Experiment in Anarcho-Capitalism: The *Not* So Wild, Wild West', *The Journal of Libertarian Studies* 3(1)1: 9.

——— (1983), 'Privatising the Commons: An Improvement?', *Southern Economics Journal* 50: 438–50.

——— & R. Johnson (1986), 'The Problem of Instream Flows', *Economic Inquiry* 24: 438–50.

Australian Chamber of Commerce (1990), *Market-Based Approaches to Environmental Management*, Canberra.

Bennett, J. & W. Block (eds) (1991), *Reconciling Economics and the Environment*, Institute of Public Affairs, Melbourne.

Bureau of Agricultural and Resource Economics (1991), *Management of Irrigation Water in the Murray-Darling Basin*, AGPS, Canberra (Discussion Paper 91.6).

Bureau of Industry Economics (1992), *Environmental regulation: The economics of tradeable permits — A survey of theory and practice*, AGPS, Canberra (Research Report no. 42).

Commonwealth Treasury (1990), *Economic Round-Up June 1990*, AGPS, Canberra.

Demsetz, H. (1967), 'Toward a Theory of Property Rights' *American Economic Review* 57: 347–59.

Eckert, R. (1979), *The Enclosure of Ocean Resources*, Hoover Institution Press, Stanford University, California.

Ecologically Sustainable Development Working Groups (1991), *Final Report*, AGPS, Canberra.

Economic Planning Advisory Council (1992), *Managing Australia's Natural Resources*, AGPS, Canberra (Council Paper No. 49).

Grayson, C. (1978), 'Is prostitution a service industry or a regulated utility? — Dilemmas of a Price Controller', pp. 201–11 in *Wage-Price Control: Myth and Reality*, Centre for Independent Studies, Sydney.

Greiner, N. (1990), 'The New Environmentalism: A Conservative Perspective', New South Wales Government, Sydney, April.

Hahn, R. (1991), 'Meeting the Growing Demand for Environmental Protection: A Practical Guide to the Economist's Toolchest', University of New South Wales' Workshop on Market-Based Environmental Policy, 20 March.

Industries Commission (1990), *Annual Report 1989–90*, AGPS, Canberra.

Keller, A., O. Lissitzyn & F. Mann (1938), *Creation of Rights of Sovereignty through Symbolic Acts 1400–1800*, Columbia University Press, New York.

Millington, P. (1991), 'The Water Market — A NSW Case Study,' *The New Environmentalism: Applying economic solutions in the real world*, NSW Cabinet Office and the Department of Water Resources, 18–19 March.

Moran, A. (1990) 'Protecting the Environment Using Market Mechanisms', ACC/ Westpac Economic Discussion Papers No. 2.

Moran, A., A. Chisholm, & M. Porter (eds) (1991), *Markets, Resources and the Environment*, Allen & Unwin, Sydney.

Murray-Darling Basin Commission (1992), 'Watering the Barmah-Millewa Red Gum Forest', AGPS, Canberra.

Musgrave, W. (1988), 'Alternative Use for National Water Resources', Irrigation Association of Australia (Symposium on Irrigation in Australia: Beyond the Bicentenary.

New South Wales Department of Water Resources (1991), *Annual Report 1990–91*.

Parliament of New South Wales (1983), First Report of the Joint Select Committee of the Legislative Council and Legislative Council to Enquire into the Western Lands Division of New South Wales, Government Printer, New South Wales.

Pigram, J. (1991), 'Property Rights and Water Markets in Australia: An Evolutionary Process Towards Institutional Reform', Centre for Water Policy Research, University of New England, Armidale.

Rose, C. (1990) 'Energy and Efficiency in the Realignment of Common-Law Water Rights', *The Journal of Legal Studies* 19(2): 261–96.

Smith, B. (1990), 'Mining and Mineral Processing', Conference on Microeconomic Reform in Australia, 19–21 September, Centre for Economic Policy Research, ANU, Canberra.

Tasman Economic Research (1990), 'Forests and Markets: A Submission to the Resource Assessment Commission', Tasman Institute, Melbourne.

Tullock, G. (1975) 'The Transitional Gains Trap', *Bell Journal of Economics* 6(2): 671–8.

de Vany, A., R. Eckert, C. Meyers, D. O'Hara, & R. Scott (1980), *A Property System Approach to the Electromagnetic Spectrum*, Cato Institute, Washington D.C. (Cato Paper No. 10).