STAKEHOLDERS AND THEIR PREFERENCES IN SETTING WATER CHARGES

George Antony*

Paper presented at the Annual Conference of the Australian Agricultural Economics Society, University of Western Australia, Perth, 14-16 February 1995.

This paper does not represent the position of the Department of Primary Industries: all views expressed are the author's own.

* Strategic Policy Unit, Department of Primary Industries, GPO Box 46, Brisbane Qld 4001. Phone: (07) 239-3818, fax: (07) 239-3860, e-mail: antonyg@dpi.qld.gov.au

CONTENTS

1
INTRODUCTION

1.1 The Problem

Water charges[1] are at the core of irrigation management, with implications for the management of water resources in general. Given the diversity of interests involved in water-resource use and the scope for conflict among those interests, setting water charges is a difficult balancing act. The socially optimal level of water charges would, ideally, satisfy society's objectives in economic efficiency and social justice.

- Economic efficiency equally applies to water users, suppliers and taxpayers. It can be quantified in an objective way, by investigating how close the trading price of the resource is to the price it would attract in its best alternative use, its opportunity cost. If price paid is less than the opportunity cost, using the resource causes an efficiency loss.

- Social justice requires equitability in the distribution of the financial and non-financial costs and benefits of water use; between groups of users, between users and the wider community, and between generations. Social justice is a subjective perception of objective factors, and it may conflict with the efficiency objective.

For most goods, markets provide a means for price discovery that best satisfies the above criteria. It has been only recently that market mechanisms were allowed to play a role in water charging in Australia; in the auctioning of water entitlements in new irrigation schemes and the gradual introduction of transferable entitlements for existing schemes. Kaine et al. (1991) provide some examples of how markets for water entitlements could assist in achieving, simultaneously, individual users' profit objectives and the broader community's environmental goals.

Water supply and use has unique characteristics: a monopoly supplier, many users, especially in irrigation, and external effects on others that are not reflected in the payment for water. As these characteristics increase the likelihood of market failure, there are substantive arguments for some regulation of the market. However, administratively setting charges is a complicated task:

- There is no single level of water charge that could be called the social optimum. Rather, all interested parties ('stakeholders') have their own minimum requirements ('thresholds') that may, or may not, be reconcilable. Each threshold has theoretical and practical advantages/disadvantages from the point of view of the dual social objectives of efficiency and justice.

---

[1] Traditionally, the price for irrigation water has been established more by administrative means than by market mechanisms. For reasons of clarity, a distinction is made in the rest of the paper between price (defined as the result of market bidding between suppliers and customers) and a charge (that is administratively set).

- The desires of all stakeholders can rarely be satisfied at the same time, and a compromise is needed. Unfortunately, even if the outcome is the same, people tend to accept any conflict resolution more easily if they negotiated it than when it is imposed on them by outsiders.

1.2 Objective of the Paper

Awareness of the implicit assumptions and limitations of different thresholds and their relationship with the interests of the players is necessary for policy setting on water charges, and it is hoped that this paper may assist policy makers by reviewing these issues. Hence, the purpose of this paper is to:

i. identify the stakeholders in rural water supply,
ii. review the stakeholders' interests in using water resources, and
iii. describe each stakeholder's preferred thresholds in determining water charges.

The interests of the supplier and users are outlined in the next two sections. These are followed by a review of third parties, those constituting different sections of society, living in different regions, and future generations.

It is not the objective of the paper to offer the method for indentifying the socially optimal level of water charge. Instead, the final section contains some observations of the options for resolving the problem of conflicting objectives and of the analytical approaches aimed at finding a compromise between the various interests.

2
THE SUPPLIER

Due to the high capital requirements and various institutional factors (e.g., the power to resume land), rural water storage and supply systems worldwide have been mostly funded and operated by governments. The organizations operating the systems were, initially, also part of the government bureaucracies, but over the years they have become more separate entities. In some countries (e.g., Britain, New Zealand) some sections have been put on a commercial footing or even privatized. This process has markedly changed the attitudes of suppliers to water charges.

2.1 Subsidized Service Orientation

Infrastructure for rural water supply has been typically built by governments all over the world. As the initial objective was overwhelmingly rural development (attracting settlers to rural areas in Australia, alleviation of rural poverty in India), to be facilitated through irrigation schemes, establishment and operating costs mostly have been met from government budgets. Under such circumstances, the agency running the scheme on behalf of the

government was not concerned about the way water charges were set, or if users were charged at all, as the difference between costs and revenues was forthcoming from the government budget as a subsidy (see Pearce and Warford 1993, pp. 174-179, for examples).

Such a pure subsidy orientation is not prevalent in developed countries nowadays, as governments are trying to reduce outlays and user charging for services is gaining ground. The first sign that the old status quo is becoming less supportable is a change in language: the expression 'subsidy' is replaced with euphemism such as 'community service obligation'. Subsequent change reduces the role of government in running and financing rural water-supply schemes, but rarely as radically as in New Zealand (Garrard 1989, Boston et al. 1991). There is usually a period of transition to a commercial orientation, its length determined by the relative strength of the rural lobby and the political will to change. The budget constraint of the supplier hardens only gradually, and there remains a scope for obtaining subsidies from the state budget. While this situation exists, the supplier may be more interested in lobbying for subsidies than in reducing its dependence on them by trying to recover its costs from water charges.

2.2 Commercial Orientation

A hard budget constraint is the precondition of a commercial orientation. That is, the supplier must cover its costs from its own revenues, and there is either no government subsidy or the supplier has no influence over its level. The interest of a commercially-oriented supplier is to cover the actual costs of its operations and return a profit.

There is often a confusion about the definition of various cost items. Fixed and variable costs are usually separated, but it is not always appreciated that their definitions depend on the time horizon considered. In the long run all costs are variable, while from one day to the next there may be no scope to vary any of them. If single years are considered, variable costs consist of operating and maintenance (O&M) costs that are expended for the physical operation and maintenance (but not renewal or repiacement) of the facilities. Over the same period, fixed costs are mainly those associated with the existence of capital items (e.g., debt service for past investment and sinking fund for future renewal). There are grey areas: e.g., salaries of people on long-term contract may be a fixed cost from one year to the next. While commercially-oriented suppliers (unlike subsidized service providers) can be expected to have a clear picture of their O&M costs, the identification of capital costs is likely to be a problem. There are two methods for that: the utility approach and the cash-needs approach (Raftelis 1993).

2.2.1 Costing capital through the utility approach

The utility approach relies on standard accounting rules for the determination of capital costs. These are derived from depreciation and adjusted for changes of the capital stock in the year, 'contributions in aid for construction' and 'customer capital advances'. In the U.S., there are strict rules governing the return a utility can achieve. 'Allowable' investment by the owners forms the rate base and the return is linked to interest payments on outstanding debt, the funding of certain capital items, and a dividend to investors. The cost of debt and cost of equity make up the rate of return: cost of debt is payments on borrowings and cost of equity

is a percentage the utility is allowed to pay to equity holders. Government-owned utilities may not aim to pay return on equity.

The advantage of the utility approach is that clear rules are followed and the scope for conflict over the determination of charges is reduced. One of the problems with water markets is the unequal bargaining power of the many small customers and typically monopoly suppliers. Justifiably or not, customers are suspicious that suppliers will use their monopoly power to reap unfair profits. Having clear rules for the supplier to follow is one way of allaying fears among customers. For this reason, the utility approach has been used as a tool for regulating various privately-owned utilities. Against this greater social acceptability of the approach there is a considerable disadvantage facing management: the allowed revenue levels may be well below or above the actual cash-flow requirements, making it difficult to run the utility as a business.

2.2.2 Costing capital through the cash-needs approach

Predicted actual cash requirements form the basis of the cash-needs approach. Capital costs are made up of such components as debt service (principal and interest), capital outlays as and when necessary and contributions to reserve funds. While this approach matches government budget practices (i.e., cash accounting) and allows flexibility, it has disadvantages also. If financial reporting is done following standard accounting practices, large net profits or shortfalls can appear. It is subjective, requiring both good judgement about future capital requirements and an ability to justify one's decisions in face of criticism. If the supplier has unconstrained monopoly power, there is little incentive to be frugal with expenditures.

Given its greater latitude, the cash-needs approach would be preferred by an entrepreneurial supplier over the restrictive utility approach. However, charges set on the basis of the less businesslike utility approach may be more acceptable to clients and regulators, since they are based on 'objective' rules and are less likely to fluctuate.

2.2.3 Consequences of past decisions

Deciding on the best way to treat current capital costs is solving only part of the problem, as it does not deal with adverse consequences of past investment decisions. As in most other countries, economic efficiency was rarely the main decision criterion in the development of Australia's water resources. The overriding policy objective of regional development,[2] coupled with easier money than today, "had encouraged investment in non-economic facilities and over-engineering of systems" (Industry Commission 1992, p. 58). "On both commercial and environmental grounds, some parts of the public irrigation systems ... will not warrant refurbishment" (p. 206). In other words, rates of return to past investment may be low or negative when calculated over asset values based on the current cost of replacing the item.[3]

---

[2] Australia is not unique in this respect. The same applies to the countries in the Asia-Pacific (ESCAP 1981, p. 7) and developed countries such as the US and France (Herrington 1987, pp. 93-95, 118).

[3] This 'deprival value' is an accounting measure, aimed at standardizing the values of infrastructure items of different age. While it could mean opportunity cost (e.g., capitalized revenue forgone if deprived of the

The issues of standard of service, asset valuation, charge-setting policy and returns are unseparable. Past investment often led to a standard of service in excess of the minimum required (e.g., in dam safety) or the economic optimum (e.g., in reliability of supply). While not charged even the full costs of delivery, water users are happy enough to accept a high standard of service; if faced with paying full costs, they begin to think about value for money. Overly high standards of service are economically inefficient, with costs borne either by water users (if forced to pay for a service they do not need) or by taxpayers (if subsidized service delivery below cost is continued). Still, adjustments of standards of service may not be possible for technical reasons and termination of the service may be politically unacceptable. In some cases, objective circumstances (climate, soils, etc.) in the scheme area may not allow such productive activities that would recoup even the delivery cost of water provided at a bare minimum standard.

If the supplier is expected to recover historical costs of establishment (i.e., service the debt and generate a rate of return on past investment), the charge it must set may exceed what its customers are willing to pay. If valuation of the supply infrastructure is to be done on the basis of expected earnings capacity (capitalized future revenue flows), the level of water charges must be known first. Decisions about these matters are often out of the hands of the supplier that merely manages the underperforming, usually publicly owned assets. In the end, government policy decisions are needed that consider the interests of all parties and find the best compromise.

3
THE WATER USERS

Water users are, obviously, direct beneficiaries of water use. They may also suffer disadvantage through their water-using activities (e.g., waterlogging and salination of irrigated farms).

Most customers of rural water-supply schemes are farm businesses: urban utilities and industrial users are fewer in number. While larger industrial users and water utilities may have some counterweight to the monopoly supplier, small users are no match. For this reason, and due to the increased uncertainty compared to administratively determined, fixed charges, small users are understandably apprehensive about free-market regimes that a reform process may introduce. At the same time, farmers particularly are suspicious of regulators and bureaucratic solutions to issues such as determining water charges.

While it is in the customers' interest to minimize water charges, this is not their only objective. Entitlements to water and the extent of farmers' property rights over them (i.e., the right to trade them) have an effect on land values. At some stage, entitlements may become a separate commodity. As such, the trade values of water rights, land values and water charges are closely linked and decision makers should take all three into consideration.

---

item), in practice it seems to be just the current cost of replacing the item. The latter is clearly deficient, as it does not address the issue if it would be justified to replace the item if somehow deprived of it.

3.1 Approximating Users' Thresholds

As there are no water markets, there are no direct ways to discover the level of water charges that is acceptable to users. As users do not usually volunteer information about their reservation level for water charges, the latter need to be identified through indirect means. Determination of users' capacity to pay through budgeting is a usual practice, and the numbers obtained are sometimes used for the willingness to pay.

3.1.1 Capacity and willingness to Pay

Profit maximization alone is inadequate to explain business decision-making, particularly by small businesses such as farms (e.g., Anderson, Dillon and Hardaker 1977). There are other objectives in addition to profit, and some of them may be in conflict. Risk aversion is now widely accepted as a motivation influencing economic decision-making, and it has become part of mainstream cost-benefit analysis (e.g., Pearce and Nash 1981, Ch. 5).

In a textbook market, buyers accept or reject a price, thus showing if they find it acceptable for their purposes. Depending on demand, sellers may be forced to reduce the price or they may have the scope to increase it. In the absence of a market, the buyers' objective and subjective situations need to be considered when setting water charges. Capacity to pay (CTP) and willingness to pay (WTP) are measures used for this purpose. To make a distinction between objective and subjective conditions, perhaps a sharper distinction is made here between CTP and WTP than is usual in the literature.

CTP is defined here as a measure of objective conditions. For valuing an input of production, as measured by outsiders, CTP tends to be based on a deterministic profit analysis that ignores risk. If so, it cannot be the sole determinant of any one user's decisions. It also needs to be stipulated if CTP is to refer to the current situation where production structure, enterprise mix and technology are fixed, or to a potential situation where a different (possibly better) enterprise mix and technology can be used. Where current and potential CTP differ, planners should make allowances for the costs of transition from the current system to the potential one. These may be prohibitively high in the short run but diminish over time, following the pattern of replacing assets that determine production in the short run.

Willingness to pay (WTP) for a resource is determined by users' subjective perception of their capacity to pay, and it is a function of utility expected from using a resource. For a given technology option, WTP is equal to CTP only for purely profit-maximizing decision-makers who are indifferent to risk or operate in a perfectly predictable environment - that is, never. With multiple objectives, including risk aversion, and an uncertain environment, WTP is less than CTP. The extent to which CTP and WTP diverge is a function of: (a) each user's objective conditions (financial situation, phase in the family cycle, extent of risk aversion, etc.); (b) the user's subjective perception of the probabilities of future outcomes (weather, prices, etc.); and (c) the user's goal structure. Using a deterministic CTP in lieu of the true WTP is, therefore, a very severe simplification. It introduces a systematic bias in the estimation, as CTP must be expected to exceed WTP under normal conditions, for a given enterprise and technology combination.

However, utility functions cannot be satisfactorily aggregated (Arrow's Impossibility Theorem: see Just, Hueth and Schmitz 1982, pp. 42-45). Hence, even if all individual

decision-makers' utility functions, and WTP, could be derived, one should not expect to obtain a single value for the water resource that is applicable to a region. As the WTP elicited from individual users is the only information available, it needs to be used - but with caution.

Another problem with CTP/WTP is its static nature, making it relevant only to one point in time. If WTP is to be used as a basis for setting water charges, it would have to be recaluted regularly to allow for the fluctuations in WTP following changes in the physical and economic environments. This is expensive, hence a substitute for recalculating WTP is desirable. "the usual cost-saving calculations ... attached by simple engineering studies" tend to be restricted to recalculating profit with a different cost for one input (Just, Hueth and Schmitz 1982, p. 155). However, this is an unsatisfactory way of predicting welfare effects of changes in the price of an input in a production system. Relative factor prices determine the production structure, hence change in one price may lead to a realignment of the production system. Hedonic pricing may be better suited to monitor welfare changes.

3.1.2 Hedonic pricing

Hedonic pricing is a method that has been used for the valuation of non-market goods, e.g., air quality or noise (Pierce and Nash 1981, pp. 136-139). Where the value of the good itself cannot be established in a market framework, a closely related market for some other good is used as a threshold (such as real-estate prices in areas where there are significant differences in air quality or noise levels). In the pseudo-market situation of water supply, hedonic pricing may be used for updating information on WTP.

In the case of water charges, the closest market is that for water entitlements. Although the current level of charges influences the level of prices paid for entitlements, the two together are still the best indicator of WTP. The market for water entitlements is clearly closely related to demand for irrigation water. The conceptual requirement of identical utility functions for consumers becomes less restrictive if actual transactions are taken to indicate the marginal rather than the average WTP. The problem of too few transactions may persist, and observed 'market' prices for entitlements may need to be subjectively smoothed out using expert opinion.

3.2 Negative Effects on Users

Waterlogging and salination are examples of 'collateral damage' that irrigation farmers can inflict upon themselves through water use. For some time, the remedying of such symptoms, via various soil-conservation techniques such as drainage, was treated as an issue quite separate from water supply. The subsidies provided in developed countries for soil conservation thus constituted an indirect subsidy on irrigation water use: users were not paying the full cost of resource use even if they happened to pay the full cost of water delivery. If water is in short supply, this practice disadvantages potential users of the water who cannot obtain allocations even if their water use would not create a need for associated soil conservation. Hence, it is in the interest of holders of water allocations to keep the costs of soil conservation separate from those of water supply.

Fighting on-farm damage from irrigation provides some indication of the value of water in irrigated agriculture. The amount water users themselves are willing to commit to amelioration must be proportionate with the expected benefits from water use. Hedonic pricing that considers the expected production loss without improvement, costs of irrigation water and the costs of amelioration can indicate the lower range of WTP for irrigation water.

4
THIRD PARTIES

Effects of water use on third parties, actual costs or lost opportunities caused to others, are as yet rarely included in water charges. Such impacts of water use on well-identifiable third parties as salination or pollution have been relatively well documented and quantified. Much more difficult is the identification and quantification of such effects as, e.g., habitat change due to altered seasonal flows. Concerted actions by sections of society not directly involved in water use in particular localities have shown that there is broader community concern about local decisions. While such concern must not be ignored and it should be reflected in water charges if appropriate, it is also difficult to measure.

4.1 Contemporaneous Interests

4.1.1 Identifiable third parties

Externalities and secondary costs/benefits refer to effects on third parties. 'Externality' is mostly used to denote a negative physical impact (technical externality: siltation, salinity, etc.), but it can also be positive (e.g., flood-mitigating effect of a dam built for irrigation, higher water table providing more moisture at root level). Secondary costs and benefits are third-party effects quantified in money terms, sometimes called pecuniary externalities.

Third parties disadvantaged by others using water can expect to be compensated. The 'polluter pays' principle is gaining acceptance and can take the form of salt levies, drainage charges, etc. added to the water charge to 'internalize' what used to be a negative externality. Apart from collecting funds for financial compensation, these also send a price message and can reduce the activity that generates negative third-party effects. Economic efficiency and fairness can coincide: if the economic activity is still viable after paying appropriate compensation then its continuation leads to a net social gain.

People suffering negative externalities are likely to be vocal about their interests, lobbying the regulator to act on their behalf, or seek compensation through legal means. Those enjoying positive externalities would rarely come forward on their own volition. There are examples where external beneficiaries have 'contributed' to the costs of building or running water-supply infrastructure, after is was completed (e.g., towns paying for flood mitigation that originally was not the reason for building a dam). Even if identified, the legal grounds to collect some kind of rent from them are not firm.

4.1.2 Regional and sectional interests

It is clearly in the interest of a region or section of society to secure and maintain a net inflow of external resources, and water-supply schemes have been a popular vehicle for that. As the regional impact of water-supply schemes can be significant, governments have used them as tools for regional development worldwide. The establishment of the scheme represents an initial transfer of resources into the region and, if water charges do not recover the costs of supply, the transfer may continue in the form of subsidies.

Perfectly rationally, regions and sections of society seek to maximize the amount of subsidy that can be extracted from governments and lobby to achieve that. The subsidy is particularly critical in the case of such water-supply schemes that do not cover even their operating costs. Many irrigation schemes around the world fall in this category: farmers do not have the capacity to pay for the full cost of water. Driven by efficiency considerations, national-level decision-makers would nowadays at least consider the closure of such schemes. This might have disastrous local effects on the water users and, possibly, on the regions through economic flow-on effects. In their fight against such eventualities, regional/sectional lobbies find a natural ally in the supplier whose importance would be reduced by the closure.

The case put up to prove the value of resource transfers to the region or a section of water users usually emphasizes regional benefits, often making use of regional multiplier effects calculated with input/output analysis. Less common is the elaboration of the opportunity cost of cutting out subsidies, complete with details of such effects as increased welfare payments to the region and the social effects of resulting unemployment.[4]

4.1.3 General community interests

Media reports often suggest that the interest of the community[5] is twofold: (i) maximum utilization of the existing, publicly-owned infrastructure, and (ii) using the water resource in the way that creates most benefits. Depending on the meaning given to these objectives, they may be in conflict.

(i) Utilization of infrastructure

Making most of existing assets is a laudable objective, but different criteria for measuring achievement can have contradictory implications. At the simplistic level, maximum utilization is sometimes equated to running the infrastructure at full capacity ("since we have it we must use it"). Such an interpretation ignores the fact that some infrastructure items cannot be operated profitably and the community may be better off if they were not used at all.

A more sophisticated measure of utilization of the infrastructure is the rate of returns to assets (ROR), possibly leading to the prescription of a target or threshold rate. While this creates the appearance of doing something to ensure efficient use of assets, it makes

---

[4] This kind of analysis is complicated in countries with a state/federal government structure. If one level of government pays the subsidy to water users while welfare payments are covered by the other, the replacement of subsidies with welfare payments involves two budgetary processes and blurres the incentives.

[5] By 'general community', those members of the community are meant who are not part of the 'user', 'supplier' or 'identifiable third party' categories.

questionable economic sense. The denominator of the ROR is asset values, but asset valuation is not an exact science. The only firm reference point, historical cost, is irrelevant for current decision-making: it cannot be changed (it is 'sunk'), and due to inflation and developments in technology it may bear little resemblance with the cost of building the item today. Using the current replacement cost (or 'deprival value) is no solution, and not merely because it too becomes obsolete and has to be recalculated regularly. Construction costs, past or present, actual or imputed, may differ substantially from the true value of an existing item - its market value. The estimate often used to approximate the market value of an asset is its capitalized future income-earning capacity that, in turn, is a function of the charge users pay. Hence, the ROR and the charge are mutually dependent on each other and one cannot be calculated without first fixing the other.

Even if it could be calculated in a meaningful and accurate way, ROR would still remain an accounting category rather than something on which decisions about the future can be based. The decisive criterion relevant for measuring the efficiency of operating an infrastructure item is whether the benefits generated exceed the variable (i.e., avoidable) costs or not. If the answer is no, termination of supply is the best decision. If yes, keeping the item in operation is the right decision, and the issue then becomes how to maximize the value from its use. It is in the community's interest to move beyond the recovery of variable costs only. This may involve covering all costs (including unavoidable ones such as debt service) and achieving a return on investment. The World Bank requires in its investment projects the recovery of "at least the public sector's operation and maintenance costs and up to 100 per cent of all direct public costs of proje Duane 1975), with actual recovery rates falling far short of total costs. This policy allowed . ..ch discretion in practice.

(ii) Benefits from water use

Community benefits from water use take many forms, with community perceptions about the benefits changing over time. The most important current trend is the increasing relative importance of environmental objectives at the expense of economic use, e.g., power generation or irrigation. Maximization of benefits would assume the water can be reallocated between different uses. This is often not the case, either for physical reasons (existing infrastructure may be too inflexible to allow it) or for legal reasons (commitments made to maintain a particular water use at a certain level).

Maximization of benefits from water use requires the estimation of benefits from various uses. Revenue from paying customers is easily measured in dollar terms, but the maintenance of environmental attributes or recreational values elude such measurement. Nevertheless, as they are considered increasingly important by the community, they need to be measured.[6] Mitchell and Carson (1989) introduce some of the methods that can be used for quantifying the value of non-economic assets (or the value of economic assets in non-economic use), usually through trying to measure the willingness to pay (WTP) by various members of society for enjoying such non-financial benefits. Contingent valuation (CV) and other techniques are still developing, but they are increasingly used as analytical aids for practical problems (Sinden 1993).

---

[6] Especia. y in the US, pressure for measurement in financial terms comes in the form of lawsuits over environmental damage (Bergstrom and Dorfman 1994).

Even if the non-financial values attached to current use of water can (could) be satisfactorily derived, that starting set of values has relevance only within a narrow range of reallocating water. Since these values reflect perceived scarcities of the resource in a particular use, as the extent of scarcity changes so would the value of the resource. Since community perception tends to change over time, the estimates are also subject to obsolescence. Administrative allocation of water to the most productive or socially desirable uses is complicated by this obsolescence of estimates that indicate where the most productive use is.

If users are allowed to sell and buy allocations, there is scope for reallocation in a secondary market[7] which would improve the efficiency of use (provided that increased negative externalities do not cancel out the efficiency improvement). While a more efficient water allocation is in the community's interest, any margin that is charged in the secondary market will not accrue to the water supplier. The community may want to maximize the direct revenue from supplying water, to relieve taxpayers and/or spend on other, perhaps more deserving, sections of the population.

The community does not speak with one voice, rather through a variety of lobby groups. Treasury Departments (State and Commonwealth) would have a role as the guardians of the economic interests of the whole community. However, Treasuries have their own agenda: they tend to concentrate on balancing the current account and place less emphasis on such issues as long-term economic growth or social objectives. Hence, they are nowadays strong champions of the 'user pays' principle and their preferences are not necessarily a good proxy for broader community interests in setting water charges.

It is sometimes suggested by water users that not only they should pay for the resource but, somehow, secondary beneficiaries should also be made to pay.[8] The counter argument is as follows: While investment in most economic activity has secondary benefits, it is not accepted practice to tax the latter, over the regular tax commitments, specifically to support resource use by primary beneficiaries in a particular locality. Secondary beneficiaries typically pay a fair market price for their resources and receive a fair market price for their output. If there is no super-normal profit, there is no justification for super-normal taxation.

4.2 Intergenerational Interests

4.2.1 Marginal-cost pricing

Water users' and suppliers' short-term interests, those that tend to dominate decisions about resource use and the setting of water charges, are not necessarily in accord with the long-term sustainability objectives of the broader community. To remedy that, current charges would have to reflect long-term, rather than current, scarcities and priorities. If charges are below the long-term opportunity cost, they encourage:

i. the overuse of the resource at the present time,
ii. the building up of demand for excessive supply capacity, and

---

[7] The primary market being between the supplier and the users.
[8] For example, if irrigated agriculture boosts the local economy other local businesses not directly involved in water use (shopkeepers, insurance brokers, etc.) enjoy more custom.

iii. persisting with enterprise mixes and production technologies that may not maximize social benefits from water use.

Therefore, long-run marginal costs are the theoretically desirable basis for setting water charges (Ng 1987): the charge should be set at the cost of providing additional amounts of water in the future.

The difficulty with marginal-cost pricing is that it is not very practical (Herrington 1987, pp 65-69). Short-run marginal costs are more easily measurable than long-run ones, but are also much more unstable, as new investment makes them change radically. The long-run, 'smoothed out', marginal cost is difficult to determine, since future supply costs of, and demand for, water are both uncertain.

For this reason, average costs of service provision in the immediate past tends to be used as the threshold for charge setting. As future costs of providing water typically exceed those in previous periods (i.e., marginal costs exceed average costs), this practice underprices the resource.

4.2.2 Conservation pricing

The increasing scarcity of water is driven by population growth and growing community expectations about cleanliness, environmental uses and existence values. As long as this trend continues, it is desirable to provide some incentive to conserve water. Quiggin (1988) found surcharges levied uniformly on all users more effective and cheaper to institute and police than administrative limitations on resource use. Hence, water charges may include a component for the long-term opportunity cost, in addition to the full current costs of supply (including pollution surcharges to pay for externalities) or long-run marginal-cost based charges and its purpose is to provide an incentive for resource conservation.

5
HOW TO DETERMINE WATER CHARGES ?

The way water charges are determined may be through a market mechanism or by administrative means. Using the latter, the identification and reconciliation of stekeholders' interests is required.

5.1 Let the Market Decide

Auctioning off all available water to users, each year, without long-standing entitlements to water, would be a conceptually appealing way of finding the market-clearing price of water. The supplier could set a reservation price or revenue, below which it would be better off closing down supply, and it would maximize revenue from water sales as water would go to the highest bidder. The need for government subsidies could be minimized.

However, many factors go against such an approach. It is not a reasonable proposition where users have some type of property right in place over the allocations. While the allocation of water to the highest bidder and easy reallocation from one year to the next would mostly serve economic efficiency, the losing bidders may feel 'left out in the cold'. Auctions would introduce much uncertainty for the supplier too, as demand swings would fully impact on revenue flows. There is a potential for market failure, given the (typically) unequal bargaining power of the seller and buyers. Third-party interests unable, or unwilling, to muster funds to bid for water would fall back to pressure-group tactics, increasing the associated political risk.

On balance, market mechanisms are perhaps more applicable to allocating and reallocating water entitlements, in a stage distinct from setting water charges, as the uncertainty caused by yearly auctions of all water may be seen as excessive. For the entitlement market to work, however, the method and level of water charges needs to be known with some certainty.

5.2 Administrative Means

In the end, some administrative intervention in setting water charges is unavoidable. The questions are: what is the best charging regime, and how should the level of charges be determined ?

5.2.1 Charging regimes

The way charges are formulated is almost as important in their effect on use as their level. Uniform rates (same charge for any quantity used) and single-part tariffs (whether a single base charge or a straight volumetric charge) are simple and predictable. As such, they are conducive for business planning by supplier and user alike. If not related to water use (e.g., only base charges applied, in proportion to allocations), they would have little incentive value to conserve the resource. Purely volumetric charges (i.e., those related to actual use) send a price message if demand is price sensitive, but their variations may disadvantage the supplier through an uneven revenue stream.

The consensus in the literature favouring multi-part tariffs (e.g., Saunders et al. 1977, Herrington 1987, Lyman 1992) is due to their capacity to account for stakeholders' different objectives in water supply best. Various components of the charge can represent capital investment, delivery costs, etc. Water users can be sensitized to the costs of installing additional capacity by setting charges according to peak system throughput. There is also scope within a multi-part tariff to include a component that represents WTP. To achieve both efficiency and equity objectives, the different characteristics of each scheme, user group, etc., must be allowed for, as well as changes from one year to the next. Where resource conservation is desirable, a progressively consumption-related component of the charge, in the form of increasing block rates, can be introduced. Decreasing block rates can be used to encourage water use, although this is rarely an objective these days.

Seasonal rates are instruments for making users aware of temporary scarcities of water. Pollution surcharges are best suited for reducing non-point pollution by discouraging water use by all users in a location. A blunt instrument, but it may be the only one available.

However, the greater number of parts in a tariff, the smaller their individual incentive value and the greater the potential for confusing water users.

5.2.2 Determining the level of charge

Administrative determination of water charges must, ideally, consider all stakeholders' interests in a formal way. If the water resource is plentiful, costs and benefits of supply to each user can be considered in isolation from other users' costs and benefits. However, if there is competition for a scarce resource, the consequences of trade-offs (i.e., the opportunity cost of taking water from one user and giving it to another) must also be accounted for. This is data intensive, and processing the information may require a complex model.

Data requirements of frequently updating water charges may be considerable in the case of some stakeholders' interests. One would expect costs of service to be known for each year, and the sales of water entitlements are usually to be reported to the authorities. However, regularly eliciting CTP and, especially, WTP data of sufficient detail would be an expensive task. Hedonic pricing, based on actual bids for water entitlements, may be one way of updating an initial estimate of WTP for a few subsequent years.

Any charge that approximates a market price should reflect variations in the physical and economic environments (which variations of CTP/WTP) as well as the cost of service provision. The frequency of revising the water charge is a critical issue. Both water users and the service provider can reasonably expect some predictability in charge levels for planning their operations. Against the possibility of unexpected windfalls from quick adjustments of the charge in the favour of either party, there is the danger of quick adjustments in the other direction, diverting revenue or expenditure from the target. Too slow an adjustment of charges in the past has been instrumental in delaying adjustment to changing market conditions and preventing the allocation of water to the highest-value use.

A regulator must also appreciate the difference in humans' subjective perception of gains and losses. Knetsch (1993) summarized evidence of the psychological phenomenon that the feeling of loss makes the value of the thing lost to appear larger than the objective market value. Hence, changes in water charges may appear larger to 'losing' stakeholders than the objective change in their economic position. Since 'gainers' value their gains at the market value, the sum of perceived losses and gains with an equal market value is not zero. Calculation of the effects of such a change in the system that imposes losses on stakeholders is most complete with the use of 'aggrievement weights'.

Reconciliation of stakeholders' interests and simultaneous optimization of their profits/benefits requires something like a multi-objective mathematical programming (MP) model. Alternatively, a simulated social utility function may be constructed with a single-objective MP model where individual stakeholders are given distributional weights. The weights would have to be those of the highest-level political decision makers over setting water charges. The philosophical basis of this approach is the assumption that politicians act

as fully empowered proxies for society. Functionally, it depends on political priorities being formulated and declared in advance, and then adhered to in decision making.

Given the complexities of the modelled system, made up of physical, biological, economic and psychological components, the margin of error on the socially optimal water charge can be large. Depending on the type of water use, the consequences of error may be different. Where water use is not very price elastic (industry, base household demand in towns, stock and rural domestic use), it is not likely to be affected much by over- or undercharging. Given the proportion of water costs to total costs, users' welfare or efficiency losses from overcharging may not be very large. Undercharging would constitute a subsidy for users, but would affect water-conservation objectives only in the long run, by causing a departure from the socially desirable structure of water use.

Irrigation, in particular, is different. Given the relatively high price elasticity of demand for irrigation water (Herrington 1987, p. 92) and the large volumes involved, the potential efficiency loss caused by getting charges 'wrong' is high in this type of water use. The physical effect of over- or undercharging is not only large but highly variable in the short run, due to seasonal conditions. Another issue is the value of environmental use of water: given the difficulties in estimating it, few valuations are above dispute. Indeed, there are environmentalists who reject the consideration of economic/environmental tradeoffs altogether, and propose the application of the precautionary principle instead.[9] This author is among those who argue that the socio-economic modelling of water supply and demand is well suited for measuring the opportunity cost of preferring 'non-productive' ways of water use and making environmental-economic tradeoffs explicit.

To be meaningful, analyses of the above kind require much data. Decisions must be based on detailed information on the circumstances of the various stakeholders; information that takes time, personnel and money to collect. Cutting corners would reduce the reliability of the analytical results obtained from substandard data and make them easy prey for stakeholders unhappy with the decisions.

REFERENCES

Anderson, J.R.; Dillon, J.L. and Hardaker, J.B. (1977). *Agricultural Decision Analysis*. Iowa State University Press, Ames.

Bergstrom, J.C. and Dorfman, J.H. (1994). 'Commodity information and willingness to pay for groundwater quality protection.' *Review of Agricultural Economics* 16(3), 413-425.

Boston, J.; Martin, J.; Pallot, J. and Walsh, P. (1991). *Reshaping the State: New Zealand's Bureaucratic Revolution*. Oxford University Press, Auckland.

[9] That is, "current or future economic enterprises should not proceed, even if all other policy criteria are met, if the knowledge of their environmental impact is too uncertain and/or the risk of damage is too great" (Brown 1993).

Brown, V. (1993). 'Where the buck stops: valuing the different and the intangible.' Paper presented at the 1993 Environmental Economics Conference. Canberra, 15-17 November.

Duane, P. (1975). *A Policy Framework for Irrigation Water Charges.* World Bank Staff Working Paper No. 218, Washington, D.C.

ESCAP (1981). *Proceedings of the Expert Group Meeting on Water Pricing.* Water Resources Series No. 55, United Nations Economic and Social Commission for Asia and the Pacific, Bangkok.

Garrard, I. (1989). *Commercialisation in the Management of New Zealand's Natural Resources.* Soil Conservation Service of New South Wales, Sydney.

Herrington, P. (1987). *Pricing of Water Services.* Organization for Economic Cooperation and Development, Paris.

Industry Commission (1992). *Water Resources and Waste Water Disposal.* Report No. 26. AGPS, Canberra.

Just, R.E.; Hueth, D.L. and Schmitz, A. (1982). *Applied Welfare Economics and Public Policy.* Prentice Hall, Englewood Cliffs.

Kaine, G.; Musgrave, W.; Burton, R. and Bryant, M. (1991). *Towards Introducing Markets for Riverine Resources.* CWPR Discussion Paper No. 2. Centre for Water Policy Research, Armidale.

Knetsch, J.L. (1993). *Environmental Valuation: Some Practical Problems of Wrong Questions and Misleading Answers.* Occasional Publication No. 5. Resource Assessment Commission, AGPS, Canberra.

Lyman, R.A. (1992). 'Peak and off-peak residential water demand.' *Water Resources Research* 28(9), 2159-2167

Mitchell, R.C. and Carson, R.T.. (1989). *Using Surveys to Value Public Goods: The Contingent Valuation Method.* Resources for the Future, New York.

Ng, Y.-K. (1987). 'Equity, efficiency and financial viability: public-utility pricing with special reference to water supply.' *Australian Economic Review* 1987(3), 21-35.

Pearce, D.W. and Nash, C.A. (1981). *The Social Appraisal of Projects: A Text in Cost-Benefit Analysis.* MacMillan, Basingstoke.

Pearce, D.W. and Warford, J.J. (1993). *World Without End: Economics, Environment, and Sustainable Development.* Oxford University Press.

Quiggin, J. (1988). 'Murray River salinity: an illustrative model.' *American Journal of Agricultural Economics* 70(3), 635-645.

Raftelis, G.A. (1993). *Comprehensive Guide to Water and Wastewater Finance and Pricing.* Lewis Publishers, Chelsea, Michigan.

Saunders, R.J.; Warford, J.J. and Mann, P.C.. (1977). *Alternative Concepts of Marginal Costs for Public Utility Pricing: Problems of Application in the Water Supply Sector.* World Bank Staff Working Paper No. 259. World Bank, Washington, D.C.

Sinden, J.A. (1993). 'Valuation in Australia: the state of the art.' Paper presented at the 1993 Environmental Economics Conference. Canberra, 15-17 November.