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Refreshing Water and Valuing the Priceless

New Zealand's freshwater allocation system has run its course

Abstract

The most promising way of reducing water use and nutrient load in overburdened catchments builds on the same kind of policy New Zealand is developing to reduce greenhouse gas emissions: cap-and-trade systems that operate at the water catchment level. Because cap-and-trade approaches are more cost-effective than other regulatory approaches, they allow us to do more good at less cost than other alternatives. Developments in smart-market technology and geospatial mapping allow for smart-market solutions that overcome barriers to success in existing trading arrangements. And, if initial rights allocations respect both the existing use rights of current users and incipient iwi water claims, they build a powerful constituency in favour of environmental management institutions that can withstand changes in government.

Keywords cap-and-trade, smart markets, environmental economics, just transition, Pigovean taxation, agricultural economics

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Everything is easy in the absence of scarcity. The first fishers did not need to worry about catch limits or who owned the fishing grounds; fish were in abundance, with many more left in the sea for each one caught. The first industrial coal users did not need to worry about global atmospheric carbon dioxide concentrations; the world could easily handle those small-scale emissions. And the first to pump water from the aquifers did not need to worry about water allocations; their pumping was but a drop in the bucket.

But that kind of abundance rarely lasts. As scarcity begins to bite, new institutional arrangements emerge to manage it. But the path is rarely easy.

In fisheries, communities develop traditional fishing grounds and manage access. When the management task extends beyond the near-shore waters more easily amenable to community self-governance, regulatory measures work to limit catches. And when the race to fish becomes yet more intense, tradeable quota systems create durable institutions with an interest in conservation.

For greenhouse gases, sector-specific regulations around power generation or automotive fuel economy eventually give way to comprehensive carbon pricing through either a carbon tax or an emissions trading scheme, when public opinion finally catches up with the science. Having a price on greenhouse gas emissions can be remarkably cost-effective, encouraging those most able to reduce their own emissions to do so.

As scarcity bites in more places, we need better allocation solutions designed with sustainability in mind

In water, riparian rights are traditionally the first to emerge: 'reasonable use' standards require that your use have no particular effect on other users. But those solutions have a harder time working as scarcity comes to bite more strongly. In those cases, either other water users give way, or the environment does, and too often the cost has fallen on the latter.

Regulatory solutions emerge to manage conflicting uses, but those solutions come at a cost. It is far too easy for water allocations that were determined through the history of use to become locked in, with newcomers barred from further draws. And regulatory policy has a difficult time in weighing the merits of different potential water uses. If two users come to a council with a request to draw water from an aquifer nearing its capacity, and there is only enough water for one, difficult decisions need to be made.

These regulatory mechanisms for managing water allocation and for managing nutrient outflow become both increasingly important and increasingly cumbersome in catchments under very strong pressure. They have resulted in outcomes where many landowners, and particularly owners of Māori-held land, are locked out of land use changes, even if their uses of water would provide far more value than some existing uses.

Cap-and-trade solutions can let us do the most good for the environment

Far better management solutions are possible, bringing better environmental outcomes, effecting a just transition for those whose water uses have to change in response to increased scarcity, and allowing precious water to flow to its most highly valued uses in the process. Environmental quality is too often cast as being in conflict with economic growth. The system I propose can unlock economic value while doing more to protect the environment. And, in catchments where the environmental burden must drop by enough that there are real trade-offs against economic outcomes, the mechanism works to ensure that that improvement in environmental quality comes at the lowest possible cost.[1]

Improvements in economic market design and in hydrological sciences mean it is now possible to build smart-market systems to manage fresh water at a catchment level.

My argument comes in three parts. First, I explain why smart-market systems are uniquely positioned to manage freshwater and nutrient outflow in catchments sufficiently large for trading to be effective. I then argue that political constraints, rather than science or economics, are the largest barrier to getting there. Finally, I argue for a way of sharing the burden of getting towards more environmentally sustainable outcomes that, I hope, can make it easier for New Zealand to implement the changes necessary to protect our common future.

Why cap-and-trade? Why prices rather than rules?

First up, a refresher lesson in Economics 101 and the merits of using prices in places where prices can work well. Prices and money were never really invented by anyone. Rather, they emerged spontaneously as the product of human interaction in response to scarcity. They have persisted over millennia because they are uniquely able to coordinate between humans' infinite wants and our finite means. When something becomes relatively more scarce, whether because of changes in demand or changes in supply, the price of that thing increases. The price increase, as described by economist Alex Tabarrok, provides a signal wrapped in an incentive. The signal tells everyone that the item has become relatively more scarce; the incentive encourages those who find it easiest to avoid using the more scarce thing to do so.

Imagine if we tried managing other scarce resources through regional council consenting processes. If aluminium became more scarce, new potential aluminium users would need to apply to council demonstrating that their use was consistent with the overall shortage in supply, potentially with the agreement of another user to reduce that user's draw on supply. It would not work well. Instead, an increase in the price of aluminium encourages those most able to switch to tin to do so, and allows those who derive the most value from aluminium to continue using it.

> ... allowing there to be a price on water would encourage conservation in times of scarcity, and would ensure that those most able to reduce their own use would have the strongest incentive to do so.

The point seems obvious, but is not nearly as intuitive as it should be – as has become somewhat obvious after too many conversations on the topic. Prices on carbon dioxide emissions through the emissions trading scheme encourage those most able to reduce their own greenhouse gas emissions to do so. While many motorists pay little heed to the current $0.07/litre ETS charge on petrol, a price on carbon that is comprehensive across sectors hardly requires each and every user in each and every sector to respond in the same way. Instead, the system reduces emissions in the places where emissions reductions are least costly.

Similarly, allowing there to be a price on water would encourage conservation in times of scarcity, and would ensure that those most able to reduce their own use would have the strongest incentive to do so.

Of course, it is more complicated than that. Prices on water would work within a regulatory structure; they are not a complete substitute for regulation. But they are a very good way of sorting out which water uses should continue in times of scarcity, and which should abate.

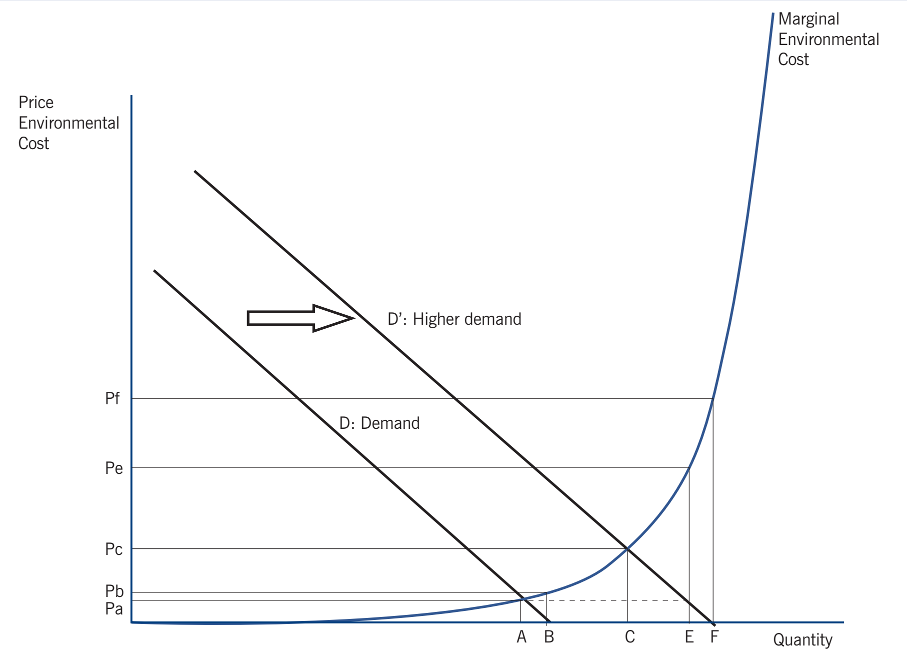
Trade beats water taxes when overuse is costly …

Shifting from Economics 101 to Environmental Economics 225, we find a strong general consensus that price mechanisms are the best way of dealing with environmental externalities like greenhouse gas emissions. Pricing environmental externalities is a very good way of encouraging everyone to consider the full costs of their activities.

But there are two different ways of putting a price on environmental costs. Government can impose a tax equivalent to the external cost of the activity, or it can set a binding limit, or cap, on the total amount of the externality produced. The former is generally considered a Pigovean tax: a tax intended to internalise external costs. The latter, when accompanied by tradeable permits for the activity within the cap, is a cap-and-trade system. In the perfect world of the economics blackboard, the two mechanisms can yield identical results: any price on an activity will result in an equilibrium amount of that activity, so choosing a price is a lot like choosing a quantity.

The two mechanisms differ when the world provides uncertainty about demand, and when the environmental costs of an activity are too sharply rising if we have got things wrong.

When thinking about greenhouse gas emissions, we have a pretty clear idea about the environmental cost of each tonne emitted, but we are less certain about firms' costs of mitigating emissions. In that case, simply setting a carbon tax makes the most sense. If we have got things wrong about people's costs of avoiding emissions, and the per-tonne cost of emissions is flat over the relevant ranges, then the costs of having got things wrong is not too high. Or, at least, the costs of getting things wrong are lower if we pick the wrong carbon tax than if we pick the wrong cap on total emissions.



When the environmental costs of an activity are unpriced, demand for the externality-generating activity will be high. Suppose that, in an early period, demand for the activity follows the schedule D. It is downward sloping: if there were a price on the activity, people would undertake less of it. The downward-sloping nature of the curve reflects that some agents will have higher costs than others for reducing their own externality-generating activity, and that different activities provide different amounts of value to the acting agent. If the price levied on the activity were high, agents would find it effective to use measures to reduce that activity until the point that the costs of those measures exceeded the pollution charge.

In the initial state, D, agents would undertake quantity B of the activity because there is no cost faced by the actor for undertaking the activity. Environmental costs associated with the activity would be Pb. The socially optimal quantity of the activity, A, and associated environmental cost, Pa, is lower than B and Pb. But the distance between Pa and Pb is relatively small.

When demand for the activity increases from D to D', perhaps because of a change in demand for the goods provided through the activity in question, associated environmental costs can begin to increase sharply. The socially optimal amount of the activity, C, is only somewhat lower than the amount F that obtains in the absence of a price on the externality. But the environmental cost Pf is far in excess of Pc.

We can now compare a cap-and-trade system to a pollution or water extraction charge. At demand level D', an environmental charge of Pc per unit of the activity would result in the socially optimal amount, C. Similarly, setting a cap under a tradeable quota system of C would result in no more than C, and would result in a per-unit value of the tradeable permit of Pc. The price and quantity are simultaneously determined. If we have a lot more certainty about the curvature of the blue curve demonstrating the marginal environmental costs of the activity than we do about the location of the demand curve, setting a quantity cap can be far better than setting a pollution charge. Suppose a council estimated that the catchment could withstand no more than C amount of the activity, and estimated that underlying demand for the activity followed the initial demand curve D. If it set a pollution charge of Pa, it would achieve the optimal amount of the activity – unless demand were actually D'. If demand were actually D', quantity E of the activity would be undertaken at the far higher environmental cost of Pe. Using a tax can be very risky where environmental costs can be sharply increasing in the amount of the activity and when demand is uncertain.

If the council had instead set a catchment-level cap of C when underlying demand for the activity were D', the cap would be optimal. If actual demand were higher than D', the trading price for permits would increase, but no more of the activity could be undertaken. If actual demand for the activity followed D rather than D', the cap would not bind – there would be no price on the activity, but the excess environmental cost is relatively small.

While it is possible to construct a tax that mimics the effect of any cap on a quantity of output, or a cap that mimics the effect of a tax, caps are preferable when the environmental costs of overshooting an expected quantity of output are very high.

That, at least, is the upshot of seminal work by Martin Weitzman in 1974 comparing the cases for controlling environmental externalities by targeting prices versus targeting quantities. Ideally, climate change would be handled through carbon taxes and mitigation subsidies rather than a cap-and-trade system.

But water is not like carbon dioxide. If we picked a wrong price on greenhouse gas emissions and wound up with emissions a bit higher or lower than had been expected, and the cost curve relating annual emissions to global climate change is fairly linear in any year's emissions, things are still pretty close to correct. The costs of abstracting too much water from an aquifer or river start rising sharply, and quickly, for water takes above the environmentally sustainable level. If the government or regional council set a price for water in a catchment that it expected would yield a demand for water consistent with an environmentally sustainable take, and if it got that price wrong, rivers could run dry in the absence of further intervention.

In those kinds of cases, uncertainty about demand and reasonable certainty that costs escalate sharply with overuse mean that quantity limits make more sense.

… and that is especially true when relevant effects are local

Weitzman's prices versus quantities result depends on the relative costs of getting things wrong under either mechanism, which depends on underlying uncertainty. When considering New Zealand's emissions in the global context, it is absolutely important that New Zealand does its part. But if forecasting failures mean that New Zealand set a carbon tax at a level a dollar per tonne lower than the socially optimal carbon tax, the social cost of that failure is rather predictable. It is the extra cost of the additional tonnes consequently emitted, less the amount collected in tax for those units: a dollar per tonne for each excess tonne.

The social cost curve does not bend appreciably if New Zealand overshoots or undershoots its targets because New Zealand is a small part of a very large and global problem. That makes it very unlikely that per-unit external costs can rise substantially with small changes in New Zealand's quantity of emissions.

Where greenhouse gases have global effects, freshwater abstraction and pollution have effects far more sharply confined to a local water catchment. Almost by definition, a water catchment under substantial demand pressure is one in which the cost of drawing an additional megalitre of water from the aquifer is much higher than the cost of drawing the first megalitre, and in which the cost of the next tonne of effluent is far higher than the cost of the first tonne. It consequently becomes far more likely that errors in setting a water or nutrient tax push a catchment into parts of the cost curve where the social cost far exceeds the tax charged on the last units. Getting things wrong in setting prices is then far more likely to have adverse consequences.

Nothing described thus far is particularly controversial among environmental economists. And many reports, from the Land and Water Forum and others, have pointed to the benefits of cap-and-trade systems.

While cap-and-trade may be excellent in theory, transaction costs in trading can be very important. Lake Taupō's nutrient management regime has seen disappointingly little trading. Similarly, transaction costs limit the potential of Canterbury's Hydro Trader system, which allows trading of irrigation consents. Buyers and sellers have to find each other – and that can be complicated where buyers and sellers may vary in the time periods over which they wish to buy and sell water or nutrient allocations.

In both cases, would-be traders need to undertake substantial and costly evaluation work demonstrating that a shift in the location of an activity does not increase the amount of burden placed on the catchment. It is far more like placing an advert in the classifieds for something that is very complicated to ship to different places than like trading shares on the NZX.

Smart markets can make trading easier while building in environmental bottom lines …

Developments in smart-market technology and progress in mapping New Zealand's hydrology, topography and geology can allow revolutionary change in our ways of managing water take and nutrients.

Accurate mapping can allow better modelling of the effects of changes in the intensity of land use on the environment. Land differs in sensitivity. Cows wintered on hillsides near rivers have very different effects on the environment than the same cows on a flat paddock with well-draining soils. Those effects will also vary with the depth of the local aquifers and subsoil geology. Those complexities are an important reason that Taupō's nutrient management system requires council evaluation and sign-off on trades in nutrient emission rights: nitrate emissions implicit in a proposed trade may be comparable, but the environmental effects will depend on where those emissions obtain.

Similarly, the effects of drawing water from an aquifer can depend on the location of the bore. A megalitre drawn near the sea will differ in effect from a megalitre of water drawn far upstream.

John Raffensperger and Mark Milke, an operations research scholar formerly of the University of Canterbury's management science department and now with the

Developments in smart-market technology and progress in mapping New Zealand's hydrology, topography and geology can allow revolutionary change in our ways of managing water take and nutrients.

RAND Corporation, and a hydrological engineer at Canterbury, developed a smart-market system for trading rights in water abstraction while respecting those environmental bottom lines (Raffensperger and Milke, 2017). The system works as follows. First, the underlying environmental constraints are set. One potential environmental constraint would be that no more water can be drawn from an aquifer over the medium term than flows into that aquifer. Another is that minimum river flows cannot fall below a set threshold during normal hydrological years. And, aquifer pressure at sea level must remain high enough to prevent saltwater incursion into the aquifer.

Water users at different node points – spots on the map corresponding to bores or locations of draws from the river – use a computerised trading interface to tell the system how much water they would like to purchase or to sell from their existing allocation at different prices. If the price of water is very high, a water user may wish to sell water back into the system for others to use. If the price is low, that same user may wish instead to buy.

The system collects all of the bids and asks before running a linear optimisation to find the set of trades that delivers the most overall value while making sure that the environmental constraints built into the system are respected. Users are then presented with the likely trading price and their consequent position as either buyer or seller. Users confirm their willingness to trade at those prices and trades are effected. The system can run as frequently as suits user demand, and there is no reason that futures markets in water allocations could not be established through the same system.

Because all trading is based on users' locations and the underlying hydrology is mapped and accounted for in the system, the price of water at different nodes can vary to reflect that it is more costly to draw water in some places than in others. This modelling then replaces the regional council's role in checking that trades have comparable environmental effects.

Nutrient management is more complex. While nitrogen has drawn greatest focus, phosphorus, sediment, E. coli and other pollutants will matter as well. And while drawing water from the aquifer can have different effects at different nodes, geological complexity can introduce substantial variation in the period over which nitrogen might reach a lake or aquifer from different properties.

> … a trading regime allows value-enhancing changes in land use while respecting and strengthening environmental bottom lines …

But there, too, the science has progressed. A team led by Clint Rissmann at Land and Water Science in Invercargill has combined fine-grained geospatial maps of elevation, soil type, underlying geology, hydrology, land cover and land use with data from thousands of water sample results to model the effects of land use intensity on environmental outcomes (Rissmann et al., 2019).

This work can be extended to form the basis for nutrient management through smart markets. Each targeted pollutant can be capped within the catchment, with each cap providing a constraint within the linear programme.

A well-developed trading system would not require users to separately purchase allocations against each cap. Instead, a trading interface[2] would capture details of on-farm practice. The system would tell users whether those uses would require purchase of a greater overall quantity of emission permits than the user holds or whether the user could sell units back into the system. It could also provide suggestions for alterations of practice that could allow the user to either reduce the number of permits they might need to purchase or to sell more units into the system. For example, shifting grazing areas to exclude areas subject to erosion would require the purchase of fewer rights within the sediment cap.

With accurate modelling underlying the trading system, the council's role would shift from evaluating trades to ensure the comparability of effects, to auditing on-farm practice to ensure that practice corresponded to the details provided into the system.

… and so we face less of a trade-off between economic considerations and environmental priorities. We can have both!

Managing water abstraction and pollutants through smart-market systems can make trading far easier. Trading is important because it allows those who can most easily change their practice to reduce the environmental burden on a catchment to be the ones to do so. Changes in practice are rarely costless, and costs can vary substantially across users.

Integrated catchment-level systems incorporating all substantial water uses, whether agricultural, industrial, commercial or residential,[3] help ensure that change happens in the places where the costs of change are lowest. In some places, the price on water through the trading system may encourage marginal dairy farms to consider selling their irrigation rights back into the system for others to use if their irrigation infrastructure were already reaching the end of its life, and to shift into lower-intensity pastoral agriculture instead. In other places, a council may be encouraged to upgrade leaking trunk water infrastructure, or leaking wastewater infrastructure, to reduce the costs it faced in the trading system or to allow it to sell valuable rights back into the system.

And decoupling water rights from the underlying land can open up still further opportunities. In catchments at their environmental limits and where no further water drawing consents are issued, historic water allocations lock in existing land uses. Even if a new horticultural operation near town could derive far greater value per litre of water used than a farm on marginal land further afield, it is currently simply too difficult for the current water user and the potential water user to effect that exchange.

Because a trading regime allows value-enhancing changes in land use while respecting and strengthening environmental bottom lines, it ensures that there is less of an economic cost to achieving those environmental objectives.

But we have to allocate to get there. Economic theory since the 1960s says it's the tradeability of rights that matters rather than who has the rights …

Tradeable rights systems require not only the definition of the tradeable unit; they also require taking a position on who is provided with those initial rights. Should rights revert to the Crown or council, with regular sales at auction through the trading system? Or should they rest with existing users?

The political economy of the initial allocation problem is non-trivial – and we will come to that part. Fortunately, the economics of the matter is far simpler. In short, so long as the trading system works well and trading is easy, the initial allocation of rights makes no difference to the final allocation of rights (Coase, 1960). If one potential user of water derives more value from that use than do other potential users, that user will either outbid others for the water, or will decline to sell water rights at a price anyone else is willing to pay.

Now, the world is more complicated than the blackboard, and it is commonplace to expect that change in farming practice can sometimes be generational rather than speedy. But, again, reasonable outcomes do not require that everyone respond quickly to the incentives provided by price signals. We do not condemn housing markets because some people would be reluctant to sell the house that they were born in at just about any price. Those who are most able to change are the ones incentivised to do so. And, under a cap-and-trade system with binding caps on overall use, every bit of use is paid for either explicitly through purchase or implicitly by using rather than selling an allocated use right.

We should not expect large differences in changes in land use under cap-and-trade that depend on the initial rights allocation. If a litre of water really is more valuable if used by a horticulturalist near town than by a marginal irrigated farm farther away, the horticulturalist would outbid the irrigator for it if the Crown auctioned off initial rights, would purchase it from the irrigator if the irrigator held the initial right, or would fail to sell it to the irrigator if allocated it in the first place.

Once we recognise that the final uses of water among users will not vary considerably with the initial allocation, we can instead focus attention on the real issues in initial allocation.

Any initial rights allocation that simply ceased renewing current consents or that expired existing consents to draw water would wipe substantial amounts of value …

… but political economy matters too. Current users have a stake

If we want the improved environmental outcomes that can obtain through better water management systems, then initial allocation decisions should be based on the political constraints that might prevent us from otherwise achieving those environmental goals.

For decades, many activities have been undertaken by right. While irrigation and water draws are now managed through resource consenting processes, having a cow in a paddock has not traditionally been something requiring specific consent. Irrigation consents are of limited duration, but are typically renewed rather than expiring. And those expectations form part of the current prices of agricultural land.

Work by Arthur Grimes and Andrew Aitken a decade ago showed that irrigated land could sell for up to 50% more than non-irrigated land; the value of water has not decreased since then (Grimes and Aitken, 2008).

Any initial rights allocation that simply ceased renewing current consents or that expired existing consents to draw water would wipe substantial amounts of value, immediately, from the fair price of that land. Farms would quickly go bankrupt, unable both to make the mortgage payments on what was supposed to have been a land purchase that included water rights, and to buy those water rights separately. This raises two obvious and related problems.

If a farm has made substantial investments in land and irrigation infrastructure based on a policy environment in which irrigation consents are renewable in near-perpetuity, and in which farms abiding by good environmental practice faced no charges for nitrogen emissions, that investment could easily be wiped out if water and effluent rights suddenly needed to be purchased every year. It may be considered morally unjust to bankrupt through a policy decision farms which have played fairly by the rules as they found them and complied with every environmental regulation they have faced.

Second, and relatedly, even if you view an irrigation consent as an administrative permission that can be withdrawn at will by the Crown or council, and are inclined to view this kind of policy change as a risk that should have been considered by the farm in the first place, not everyone feels that way. It would not take many television news specials on bankrupted farm families for the system to fall over, whether immediately or with a change in government.

And the prospect of those effects can stymie change in the first place. Anyone wishing to build environmental institutions that can deliver good outcomes across several changes in government should have an eye on the political conditions allowing those institutions to be durable. Initial rights allocations are critically important in building those institutions.

Recognising current uses can help enable a just transition

Ultimately, changes in land use should be invariant to initial rights allocations. In some places that could involve substantial changes in land use. If some farms are viable only because water effectively has no price, we should expect land use change if water comes at either an explicit or an implicit cost.

If current users' rights are recognised through an appropriate allocation of initial rights, then anyone shifting to less environmentally burdensome land uses is immediately compensated for that change in land use. Their change will have been consequent to a sale of valuable rights into the trading system that can help enable a transition to other land uses.

We have the opportunity, in considering building a better water management system for a cleaner environment, to work a just transition into the calculus at the outset through the allocation of initial rights.

But current users' rights are not the only ones at play.

We also have to recognise iwi rights

The case for cap-and-trade in freshwater management is hardly novel. Researchers have argued for cap-and-trade solutions for decades, as detailed in my recent report (Crampton, 2019). In water abstraction, the case has been clear for a rather long time. In nutrient management, it is only more recently that geophysical mapping has developed sufficiently to allow the kinds of smart markets that can work most effectively.

Fear of triggering Treaty claims has stymied progress ...

But the main barrier has not been in economic or scientific modelling. Rather, it is the following. Cap-and-trade systems require an allocation of rights, whether they are framed as tradeable property rights or tradeable administrative permissions that look a lot like property rights but are not officially considered property rights. The position of the government has been that water is unowned or, if not, is owned by the Crown. Any variation from that position has been seen as risking claims under Waitangi Tribunal processes.

The more that a tradeable permission looks like a property right, the more likely it has been seen as being legally risky. And so fear of opening difficult and potentially costly cans of worms has prevented moves towards better freshwater management. Getting catchments to operate within sustainability limits requires moves towards allocation-based systems, but allocation means litigation.

> If there exist legitimate iwi claims to water in particular catchments that were not extinguished by the Treaty, contract or sale, then there is a strong moral case for resolving those claims.

... but the costs of failing to address those claims head-on are mounting

If there exist legitimate iwi claims to water in particular catchments that were not extinguished by the Treaty, contract or sale, then there is a strong moral case for resolving those claims. But even holding the moral case to one side, the case for now resolving iwi claims, ideally through negotiation, is becoming pressing.

When scarcity and environmental limits did not bite, perhaps it was defensible to pretend that water was unowned and, in so pretending, avoid Treaty issues. However, the costs of continuing to attempt to manage water resources through suboptimal regulatory vehicles is rising.

As catchments come under increasing pressure, first-in allocation systems come at far greater economic cost as potentially higher-valued water uses are blocked by limits on further consenting. Often, that cost falls on the owners of Māori-held land who have been late to consider dairy conversions and have consequently been locked out of water allocations.

And attempting to manage environmental harms of existing uses through best-practice regulations that do not adequately recognise the heterogeneity of conditions across catchments means greater environmental cost, greater regulatory compliance cost, or, more likely, both. Cost-effectiveness in regulatory regimes simply matters more when the regulatory constraints become more binding. We can no longer afford to maintain second- or third-best management systems.

A framework solution: sharing the burden

The allocation issue is difficult enough in catchments that are not beyond their environmental limits. Once we consider that overall catchment level burdens must reduce in some places, and that iwi rights may also need to be attended to, the issue becomes more difficult. Awarding rights to existing users based on their historic consents and use rights, and additional rights to iwi, would mean that even catchments that are not currently beyond their limits would quickly be over-allocated relative to any environmentally sustainable cap.

We suggest a framework for a way forward.

We all benefit from more sustainable outcomes, so we should share the burden

The burden of reducing overall use rights in over-allocated catchments, or in catchments that would be over-allocated if all iwi-awarded rights were put into use, cannot fall on existing users alone. Doing so would bankrupt many and effectively block the implementation of a far better management system. Sharing the burden is appropriate.

That means existing water users will have to do their part, but so will the public as a whole

Consider a catchment where current use is in excess of environmentally sustainable limits: the catchment can sustain only 80% of its current burden. And suppose that, for the moment, there are no iwi water claims.

An allocation solution that places the entire burden on existing users would allocate to all users rights consistent with 80% of their existing consents (for water abstraction) and 80% of their existing pollutant burden (for nutrients). Users unable to easily change their own practice would need to purchase rights through the system to make up the difference; users more easily able to change their own practice would sell rights through the system. And users would experience a loss in the value of their properties equivalent to the loss of a fifth of their existing use rights, less any increase in the value of those use rights provided through the ability to trade in water and nutrient rights.

An allocation system that places the entire burden on the Crown would allocate rights to all users consistent with 100% of their existing use. The Crown would then buy back and retire rights within the system until the cap was achieved. Users most easily able to change their own practice would sell their rights to the Crown. There would be no reduction in the value of existing properties and would instead be the potential for an increase in value: decoupling water and nutrient rights from the underlying land can increase the value of the bundle of rights.

A sharing of the burden would involve an under-allocation of rights to current users relative to their established rights, or a time limitation on awarded rights, or both, coupled with Crown buy-back of rights through the system to get the rest of the way to environmentally sustainable limits.[4]

The proportion of the burden that should fall on current users relative to the Crown is simultaneously a question of politics and of values; economists are not well placed to adjudicate across those. If all of the burden falls on existing users, the system may not withstand a change in government if the required reduction in the environmental burden is substantial. If all of the burden falls on the Crown, costs to the Crown could prove substantial – and especially if substantial additional rights should be awarded to iwi in some catchments.

My report suggests a combination of time-limited rights for existing water users, an awarding of rights to iwi that builds over time, and Crown buy-back of rights.

Doing it well builds a system that can endure, and that can maintain a sustainable environment over the long term

New Zealand needs a freshwater management system that can withstand changes of government, has the buy-in of existing users, and makes environmental sustainability be in the interest of those in the sector.

Cap-and-trade systems can help ensure that any desired improvement in environmental quality comes at the smallest possible economic cost. But they also build a constituency for the preservation of good environmental outcomes and better environmental practice. Improvements in one's own environmental practice become profitable when a user is allowed to sell valuable rights back into the system. Systems can be more strongly self-policing if a neighbour's cheating of the system means the value of your own rights is eroded.

Putting town, industry, commerce and agriculture on the same footing by requiring town and country alike to be accountable for the environmental burden they impose, through the same system, reduces the current adversity between town and country. Farmers should face the same cost for the breach of an effluent pond as a town council would face for an equivalent discharge from a broken sewage system.

And requiring water bottlers to purchase water rights through the trading system would help in mitigating currently contentious decisions around consenting for that water use.

We suggest that central government should consider developing the kind of cap-and-trade smart market here described for trial use in Canterbury. The burden of reducing use to sustainable limits should be shared between water users and the broader community through a combination of Crown purchases and retirement of allocations, and by a structure of initial allocations that reduce current users' rights over time. A smart market in water abstraction, following the model established by Raffensperger and Milke, would require defining minimum river flows. Why not recognise that minimum river flow as the self-owning river, following the precedent in Whanganui, and recognise iwi trusteeship rights over the river as part of Crown–iwi negotiations?

Water management in New Zealand has to change. The environmental and economic costs of continuing with blunt regulatory approaches will continue to rise. Dealing with the issue will likely require the Crown to confront potential iwi claims over water. But the costs of failing to do so will only rise. We can and must do better for our environment, for our communities that rely on water use, for any legitimate iwi water claims that have been ignored by current practice, and for our future.

1 These issues are discussed in greater depth in Crampton, 2019.
2 The Overseer farm management system is currently being upgraded and could form the basis for this interface.
3 We do not expect that small residential bores would need to be covered by the trading system. Rather, council drawing consents for residential water supply would be encompassed.
4 This mechanism is developed in more detail in Crampton, 2019.

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