Grand theft water: the calculus of cost, compliance and consequence

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Abstract

Recent theft of water resources in Australia highlights problems shared in other contexts around the world. We examine the economic incentives related to water theft, both technically lawful and unlawful cases, and the impact this can have on third-party users. In Australia's case, the newly formed environmental water user and their goal of creating sustainable ecosystems are at threat from water theft. Australia's advanced stages of water reform provide important cautionary lessons for other countries, while our legal and economic assessment provides useful insight for water managers and regulators to consider. Critical reflection points are provided at the conclusion of the paper.

Keywords: water scarcity, illegal extraction, penalties, compliance

Water theft: a growing problem

In economic terms, water is a finite resource that is becoming increasingly scarce as the world's population grows, total water demand increases, and the supply of freshwater becomes more variable. Understanding legal access to water resources via rights, and the motives for individuals to circumvent those rights during times of scarcity, is thus important. The largest use-sector within the total demand for water is agriculture, typically accounting for between 70-80 per cent of consumption. Other demands for water (e.g. environmental flows) are increasingly important, creating competition between users that water regulators/managers around the world must govern effectively balancing economic growth against sustainable water use.

Australia has some of the best examples of water governance arrangements. Water resources have been shifted away from irrigated agriculture to environmental uses through transferrable property rights, market-based platforms, and public policy incentives. Australian water use reforms have resulted in net welfare gains (economic, social and environmental), which is a common objective in other parts of the world.

The advanced stage of water reform in Australian can highlight probable water regulation/management issues for other countries. A current major concern in Australia and other countries (e.g. Spain) is the illegal extraction of water by irrigated agriculture. In the Murray–Darling Basin (MDB) both *legal* and *illegal* extraction of environmental water is possible. Environmental water in this instance refers to both water recovered through purchase or infrastructure efficiency programs and/or water set aside for the environment in legislative instruments. Illegal extraction of environmental water has triggered no less than 15 public enquiries into compliance and monitoring failures (e.g. Matthews, 2017), protection of environmental water (e.g. South Australian Murray-Darling Basin Royal Commission, 2018), and the integrity of the water market (e.g. The Senate, 2018b). In response, the Basin states have moved to establish new compliance and enforcement policies, appoint independent oversight and a Federal Commissioner for the northern Basin, and regular reporting on non-compliance issues (MDBA, 2018). There has been less focus on the legal extraction of environmental water.

Reforms in the face of illegal extraction are welcome developments in response to serious breaches of public trust and the erosion of environmental property rights. However, what motivates irrigators to steal water, and why do those individuals perceive their actions as necessary or feasible? Further, why have policymakers continued to overlook the legal extraction of taxpayer-funded environmental water, which has been purchased to restore the health of the Murray-Darling Basin? As we reform compliance arrangements in the MDB, can a better understanding of irrigator motives for illegal extraction, and the importance of protecting environmental water from legal extraction assist in determining new regulatory frameworks including penalties? Finally, what are the relevant water regulation/management issues that require urgent attention?

In the global context, a wider understanding of the economics of penalties related to illegal water extraction under growing competition and scarcity is timely. Further, legal extraction loopholes offering opportunities for irrigators to extract environmental water must be highlighted and closed. Better understanding should result in more effective compliance institutions and environmental outcomes from public investment and rights. This paper outlines the negative effects of extracting environmental water, and offers some economic theory to assist regulators/mangers identify and decide effective penalties to dissuade illegal extraction in dynamic water supply/demand contexts. An illegal extraction case study from the MDB is included to highlight current reform requirements, with lessons for other countries. Finally, we discuss the importance of effective compliance and monitoring arrangements, and suggest penalty-setting arrangement applicable in most water management jurisdictions.

The impact of legal/illegal environmental water extraction

The importance of protecting environmental flows from legal and illegal extraction is based on environmental benefit and hinges on delivery protection. Concurrent water delivery from multiple sources (in this example other state jurisdictions) is crucial to achieve environmental outcomes, particularly end-of-system benefits. Legal/illegal pumping compromises flow volumes, resulting in partial delivery outcomes and flow target threshold reductions. For example, an environmental benefit at the Coorong (end of system site) may be contingent upon a flow threshold of 12,000 megalitre (ML) for 14 days at the South Australian border. However, while environmental water originating from New South Wales is protected under pumping embargoes, a Victorian component may be subject to legal pumping opportunities under regulatory arrangements in that Basin state. The legal loophole allowing pumping of environmental water from Victorian water sources may thus prevent environmental threshold realisation, as illustrated in Figure 1. The environmental manager may then be required to release a larger volume of water, to compensate, which may also be extracted, reducing the value/security of environmental rights.

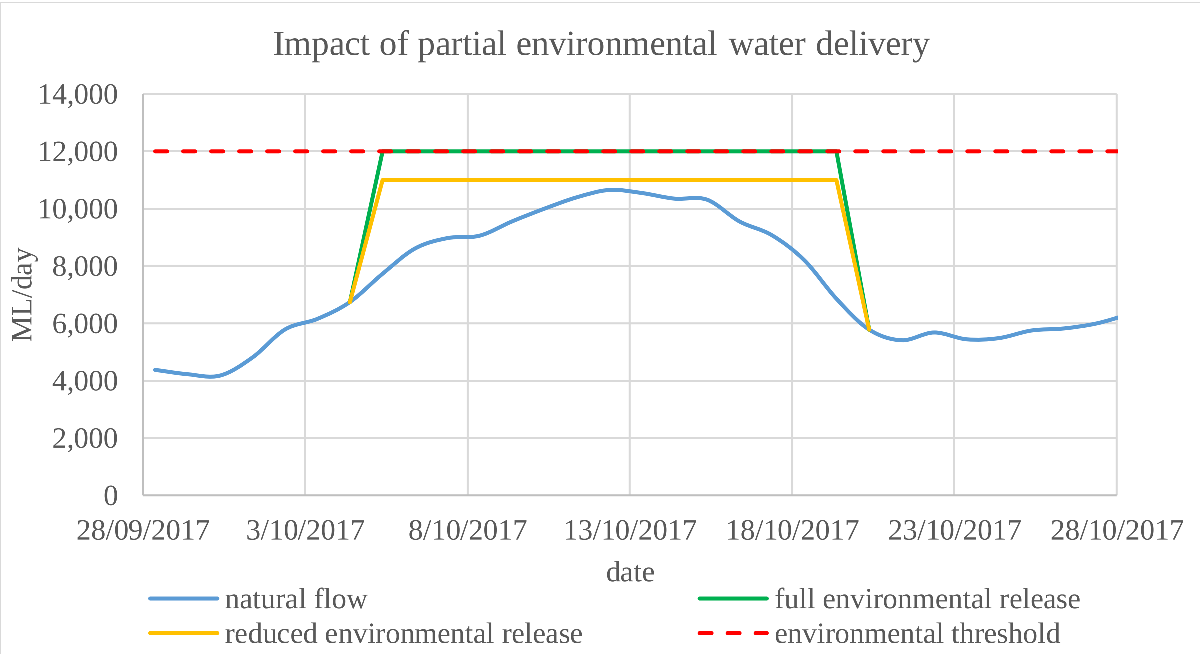


Figure 1: Impact of water extraction on achieving environmental flow targets

In theory, why would anyone steal water?

All economic goods have value, and supply scarcity leads to rapid price/value increases. Water is a prime example of a good with high value. However, water is also unique due to private and public good characteristics including: essentialness for multiple users/uses; non-rivalry in consumption; mobility and non-excludability; variability in spatial, temporal and quality terms; bulkiness to store/transport; and requirements for significant capital investments associated with use (Hanemann, 2006). These characteristics can combine to provide large incentives for private irrigators to pump water illegally. The private benefits from illegal water pumping include maximising income from production, minimising farm debt, and/or avoiding irreversible capital losses. Using the supply and demand in different states of nature theory provided by Adamson *et al.* (2017), we can consider a range of scenarios faced by individual perennial crop farmers during low water supply periods; particularly where those low supply conditions continue for several years (Figure 2).

The three states of supply include dry, normal and wet conditions; where the quantity of water available is fixed and inelastic at all times due to its finite nature. In response, perennial crop water demand can be elastic (wet), unitary (normal), and inelastic (dry). In wet and normal conditions motives for illegal extraction will persist, but may be of lower probability. However, in dry conditions the broad choice-set for perennial producers includes four options, which escalate if dry conditions persist.

In an initial dry year, perennial producers may be willing to pay well-above market prices in the short-run (SR_{Choke}) to secure water inputs (Option a). These inputs include water to maintain rootstock capital *g*, and additional volumes to achieve full production *h* and maximise profits. If the dry continues into subsequent years, SR_{Choke} investments will be economically unsustainable forcing a downward shift to long-run choke (LR_{Choke}) prices to secure *g* and *h* water inputs (Option b). Should dry conditions remain (e.g. >3 years) perennial producers may be forced back to market prices, and may only be able to afford the purchase of sufficient *g* inputs to maintain their rootstock at the expense of *h* crop productivity outputs (Option c). Note that for some commodities (e.g. almonds, which are perennial crops) reductions in the provision of *h* water may have long-term impacts on subsequent crop quality and profitability following a return to normal supply.

A corner solution emerges for perennial producers where there is no water supply, and no water can be purchased to provide either *g* or *h* inputs, resulting in rootstock, farm infrastructure, and entrepreneurial capital loss (Option d). This is a worst-case scenario that producers will seek to avoid at all costs. Therefore, high market prices, continued financial investments or debt to purchase water inputs, and/or the loss of productivity/quality will motivate producers to consider their options with regard to illegal extraction—particularly where the penalties or compliance systems are perceived as low or ineffective.

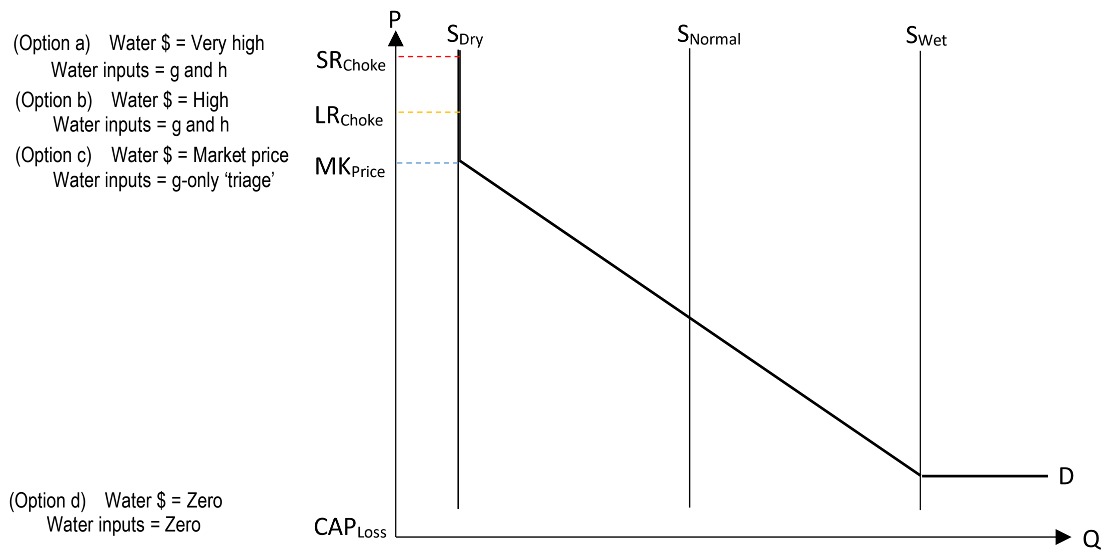
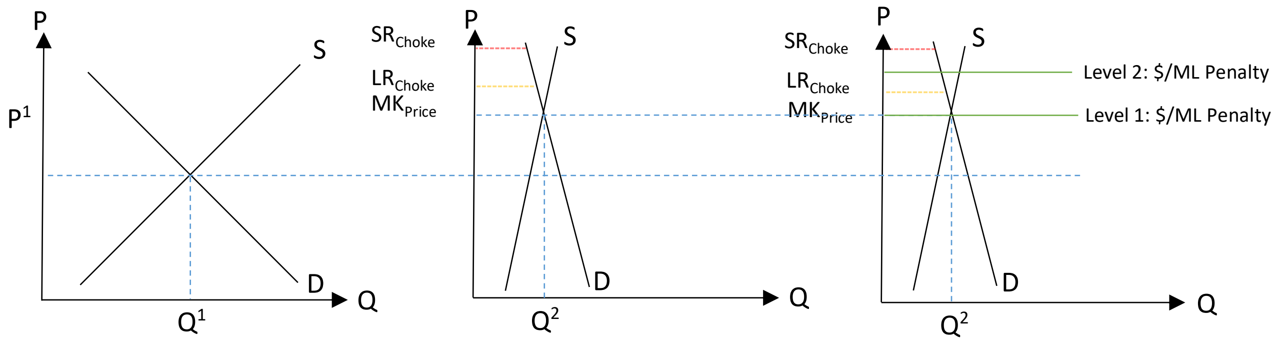


Figure 2: Perennial crop decision scenarios in response to low water supply

Annual crop producers may face similar choice options in initial dry years where delivery-contracts with specified quantities have been entered into. If they are unable to meet the agreed quantity, they will need to purchase outputs from other producers at inflated market prices, akin to the SR_{Choke} price described above. However, if the dry continues they can elect to not contract/irrigate, avoiding variable cost investments and capital losses—although their total debt may increase.

The options described above might motivate producers to assess the probability of water theft detection, enforcement and prosecution—and the associated financial penalties—and weigh them against water purchasing costs or potential farm debt/losses (Figure 3). Consistent with *revelation principle theory* and incentive compatibly in mechanism design, if the penalty approximates the market price of water during normal supply conditions then an effective deterrent against illegal extraction may occur. However, during water scarcity, that same $/ML penalty would be far below the opportunity cost of water—particularly the SR_{Choke} price some water users may be willing to pay. Note that even at a relatively high $/ML penalty (Level 2 penalty in Figure 2c) the cost per ML would still be lower than the SR_{Choke} price, providing no effective deterrent to illegal extraction.



(a) 'Normal' market (b) Dry period market (c) Penalty level per ML

Figure 3: Fixed penalties versus dynamic market pricing of water

In the calculus of penalty design, note also the cumulative effect of low probabilities for detection (DeBoe & Jouanjean, 2018), enforcement and prosecution of illegal extraction which some producers will compute for perceived ineffective institutions. If we formulate the real cost of a penalty $Prob\delta$ as:

$$Prob\delta = Fine * [Prob^{Detection} * Prob^{Prosecution} * Prob^{Conviction}]$$

where *Fine* is the spot-market dollar-value per ML penalty associated with the illegal extraction, $Prob^{Detection}$ is the likelihood of being detected while pumping illegally, $Prob^{Prosecution}$ is the likelihood of the case being prosecuted, and $Prob^{Conviction}$ is the likelihood of the producer being convicted, then we can identify a relative weakness in the compliance process. For example, the likelihood of prosecution may be relatively high (e.g. 0.8), together with the likelihood of conviction (e.g. 0.5). However, if the likelihood of detection in the first instance is very low (e.g. 0.05 where the distance between producers and regulators is large, and local compliance monitoring resources are extremely limited), then the real penalty cost (excluding legal or other transaction costs) could follow the example below:

$$\text{Total Penalty Cost} = \text{AU\$3000/ML} * [0.05 * 0.8 * 0.5]$$

$$\text{Total Penalty Cost} = \text{AU\$60/ML}$$

An AU$60/ML real cost is akin to the market price of water during normal or wet periods, when water is not the binding constraint. Further, if a producer applies any discount rate, then the real penalty cost over the lifetime of their farm investment may effectively reduce to a zero value—again increasing the incentive to act illegally.

The legal context

In Australia for example, civil penalties are legislated and then irregularly reviewed or increased in line with inflation rates. However, the courts often discount maximum penalties applied creating gaps between actual sanctions and community expectations (The Senate, 2018a). At present, Australia cannot set civil penalties based on multiples of the benefit gained. However, the Australian Securities and Investment Commission (ASIC) has suggested that either i) disgorgement of the profits obtained from illegal activity could be applied on top of an existing penalty, and/or ii) a multiple of up to three times the benefit gained should be possible in practice (ibid.). The Senate has indicated its support for such changes.

In systems where environmental water is held on licences owned by the government, and then released from public storages to meet ecological objectives, some water users may opportunistically extract this water (noting that this extraction could be either legal or illegal, depending on various factors). Where such extraction is legal and will increase productivity in the short to medium term (with on-farm storage allowing for future use), there is little disincentive to refrain from pumping to meet public objectives associated with water uses. This may be particularly true during periods of relative water scarcity when releases of held environmental water may suffice to trigger the legal right to pump; which in some circumstances is linked to flow levels recorded at the relevant gauge or gauges.

What then is the current state of regulation and penalties for illegal water extraction, and what options exist to protect environmental water from legal extraction? The following Australian case study is intended to explore these two issues within the context of the theory described above.

Case study: Barwon-Darling River

The Barwon-Darling River is located in north-western New South Wales (NSW) and is the sole artery connecting the northern and southern components of the Murray-Darling Basin. While it is considered to be an unregulated system, it is fed by 11 tributaries; five of which are regulated due to the presence of public storages. Environmental water is held on government-owned licences in four of these regulated tributaries, thereby allowing water to be released from the relevant storages to not only increase flows and achieve environmental outcomes within each tributary, but in some instances to flow into and down the Barwon-Darling River.

The Barwon-Darling region uses approximately three percent of total surface water diverted for irrigation in the Basin, with agriculture (in particular cotton) and grazing providing dominant forms of land use. Cotton farming on the Barwon-Darling River has come under close scrutiny over the last two years. Serious allegations of non-compliance with specific state-based water laws have been levelled at certain growers (including by other farmers in the region), while concerns regarding the legal extraction of environmental flows have been expressed by a number of stakeholders in other areas. After a protracted period of inaction by both the NSW and Commonwealth Governments in relation to these allegations and concerns, an exposé by Australia's leading investigative journalism program in mid-2017—as well as a civil enforcement case against one grower brought by public interest environmental lawyers on behalf of a conservation group—forced significant regulatory review and compliance updates.

Notably, a small number of large landholders on the Barwon-Darling River are now being prosecuted by a newly established regulator in relation to alleged offences under the *Water Management Act 2000* (NSW) (WM Act), some of which date back to 2015. One of these growers recently pleaded guilty to all charges (Davies, 2018). The WM Act was also amended in 2018 to, *inter alia*, increase penalties for certain offences following community feedback that existing fines were inadequate to deter potential offenders, and were not in line with penalty units in other environmental statutes in NSW (EDO NSW, 2018, pp 16-17). For example, the maximum penalty for corporations found guilty of committing a Tier 1 offence (the most serious category) was increased from 20,000 to 45,500 penalty units (with a penalty unit currently corresponding to $AU110 under the WM Act, s. 363B(a)). While this is a substantial increase, it does not incorporate the recommendations made by ASIC discussed above. Furthermore, increasing penalties in the absence of adequately resourced compliance or monitoring units, surveillance and enforcement action is unlikely to have a deterrent effect. However, with the establishment of a new regulator and renewed commitment by the NSW Government to enforce its water laws (combined with a watchful civil society), the possibility of a $5 million fine for corporations may prove to be impactful on perceived incentives to extract water illegally.

The aforementioned civil enforcement case is illustrative of the need for a multi-pronged approach to compliance and enforcement. To clarify, the case itself is not punitive in nature; that is, it is not a criminal trial capable of attracting a penalty upon conviction. However, as it was brought due to prolonged inaction by the former regulator in relation to the alleged water theft, it served to highlight ongoing failures with respect to enforcement, and the need for urgent government action. This, combined with the media exposé discussed above, resulted in the government undertaking criminal enforcement action (including against the same licence holder in relation to overlapping offences) and increasing compliance capacity across NSW. This scenario also highlights the important role that civil society organisations can play in enforcing the law, which in turn reinforces the need for open standing provisions in relevant statutes allowing any party to seek to restrain or remedy an alleged breach. With time—and as noted above—it may also demonstrate that a range of factors is likely to increase the efficacy of increased penalties.

It is also worth noting that the civil enforcement case concerns alleged offences committed during a particularly dry period (late 2014 to mid-2016). Analysis of the hydrograph for the Barwon-Darling River during this period shows that flows were particularly low, with several months of no flows recorded in December 2014 to January 2015, and March to mid-June 2016. Indeed, water scarcity resulted in the NSW Government imposing an embargo on the legal pumping under certain licence categories on the Barwon-Darling River and a number of its tributaries in the first half of 2015. The case will not be heard until 2019, which means that the allegations are yet to be tested in court. Depending on the court's final verdict, the matter may demonstrate the increased motivation to extract water lawfully/unlawfully during particularly dry periods.

Finally, during the same period (that is, April 2014 to mid-2016) the Murray-Darling Basin Authority (MDBA) piloted a study which sought to test the suitability of a Geoscience Australia satellite imagery product (the Australian Geoscience Data Cube) to understand environmental flows and whether/where these flows were being extracted. The pilot focused on one release of held environmental water from a specific tributary flowing into the Barwon-Darling River, as well as four other unregulated flow events in the Barwon-Darling. Documents obtained by EDO NSW on behalf of the Australian Conservation Foundation under Commonwealth freedom of information laws indicate that the study—which also included analysis of hydrographs, on-farm storages, crop data and cropping activity—provided possible evidence of both environmental water being extracted and extractions occurring in contravention of certain laws. The documents indicate that the MDBA's study, and to that extent any possible findings regarding non-compliance and extraction of environmental flows, were confined to a specific location on the Barwon-Darling River (between two gauges). While some information regarding this matter was released shortly after the initial freedom of information request in 2016, the more detailed and arguably topical findings outlined above were withheld for two years; that is, well after the investigative journalism program had aired, other media exposés on the study had been run, and the various court cases had commenced. This highlights the historic reluctance on the part of governments to acknowledge and address the issue of legal/illegal pumping of environmental water, and the need for strong engagement by the community and civil society organisations.

Following these events, both the NSW Government and MDBA began discussing options to protect environmental water in the Barwon-Darling River. These included the imposition of temporary embargos which are issued at the discretion of the relevant NSW Minister under the WM Act to protect releases of held environmental water, and/or statutory amendments that would require mandatory embargos to be imposed at such times (and to protect low flows). The obvious advantage of the latter is its' non-discretionary nature, which removes the possibility of human bias. Other proposals that have been mooted include the withdrawal of certain licenses that allow legal access to low flows, thereby removing the possibility of environmental flows being extracted as part of normal pumping activity.

Future requirements

The detail provided above raises a number of key points for reflection and discussion with respect to reducing water theft in both the Australian and wider global context:

Change the calculus of compliance

An obvious way to decrease water theft is to alter the calculus of penalty design by increasing the probability of detection ($Prob^{Detection}$). This could be achieved by on-farm technical solutions such as real-time telemetric metering of water extraction, and/or a higher number of site inspections by the compliance authority. Telemetry in particular has great potential in remote and unregulated systems, reducing the need for resource-intensive site inspections. This, coupled with public disclosure of usage data, would invariably increase community confidence in compliance with, and enforcement of, water laws. While the installation and maintenance of meters in remote locations can be expensive, the overall benefit to society of introducing telemetry in high-risk areas, such as the Barwon-Darling River, arguably justifies the cost. Another option is to use remote sensing and satellite imagery to monitor (illegal) extraction; this is currently being adopted in the MDB by regulators. Combined with other forms of evidence (such as seasonal crop yield, hydrographic data and/or metering data), these technologies can assist enforcement agencies to meet the criminal burden of proof, which may in turn have a deterrent effect. However, for satellite products to be effective, regulators must have the time and expertise to analyse data and imagery during a season across a large area, capacity to accurately discern the source of water identified in that imagery, and supporting information other datasets to avoid false positives/negatives that may undermine the system where such instances occur. Whatever the approach, initial steps will be for regulators to assess their penalty design calculus to identify weaknesses, and implement measures to improve probabilities.

Increase the consequences for theft

As shown above, decisions to steal water can be based on weighing the value of lost production against the total penalty cost. Very high productivity values, and/or threats of irreversible capital loss (option d, Figure 2), make water theft the rational option even at high penalty levels. Water theft can also result in environmental, cultural and other economic losses to other users, further exacerbating the impact of such activity. An extremely large total penalty can therefore be necessary to provide appropriate disincentives and compensate those negatively affected. Ideally, penalties will factor in: i) the gross benefits gained from the illegal activity, ii) the monetary value of any impact to third-parties as a result of not receiving their water rights, iii) and the costs of prosecution. ASIC's proposed three-times multiple penalties may be sufficient to cover all of these costs, making them an appropriate future set of arrangements. However, the possibility of a plea bargain may provide cheaper options for farmers considering the calculus of conviction. While we do not suggest plea bargains (or settlements for civil cases) should not feature in the process, we would urge those responsible to take the factors above into consideration when entering into such negotiations.

Additional issues

The theft cases in Australia have highlighted the importance of well-resourced (financial and human) compliance monitoring, especially in the remoter parts of delivery systems. If insufficient, current water charges could be increased to ensure resourcing, although such moves would likely be unpopular with struggling rural communities and urban areas sensitive to the challenges of farming. An option may be to rely on private water users to police instances of theft, as raised in the Australian context where neighbours are sometimes red-flagged by another, triggering detection where no state monitoring resources were present, or providing a basis for state monitoring agencies to investigate further. However, in cases involving the illegal extraction of environmental water, it is important to consider the possibility of future private collusion to gain upstream and downstream private benefits at the expense of environmental rights—particularly during dry periods and in areas where environmental water is generally viewed as usurping the rights of consumptive users. This would undermine reliability of self-policing. Therefore, public resourcing may provide the only reliable solution to water theft monitoring and compliance.

Finally, a consequence of increased surface water monitoring and compliance could be an increase in groundwater utilisation where available. When surface water utilisation is affected by pumping and/or increased restriction to legal/illegal use, groundwater becomes a more valuable product since it may not be perceived as subject to these restrictions. This would place groundwater resources and any associated rights or markets under stress, particularly where resourcing associated with bore monitoring and compliance checks were reduced. For Australia, while we remain uncertain about whether current levels of environmental rights will be sufficient to provide national benefits, we can be certain that any infringement upon those rights via lawful/unlawful extraction will make the systems unsustainable. Once again, this highlights the importance of closing existing legal options to extract environmental flows, and effective compliance monitoring and assessment across the full spectrum of water resources as the first steps to effective deterrents to water theft.

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