Integrated water management and environmental justice – public acceptability and fairness in adopting water innovations
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ABSTRACT
Innovations to manage freshwater resources and avert shortages – including conservation through use of reclaimed wastewater, desalination, and demand-side management measures such as increasing block rate structures offer practical, effective remedies for meeting future water demands. We examine the challenges confronting adoption of these innovations that revolve around perceptions of fairness and public acceptability. A major obstacle to these approaches’ adoption is environmental justice – that the risk and burden of resource solutions, as well as their benefits – should be borne equitably, despite differences of income or race. We first consider how debates regarding water supply are often disputes over different notions of environmental justice. We then examine general equity debates over adopting various innovations in one US state at the nexus of water demand and supply innovation: California. We contend that fairly adopting these innovations requires embracing open, inclusive, and transparent decision-making processes in which no important constituency is excluded from decisions, and in which different notions of environmental justice are embraced.

INTRODUCTION
In recent decades, there have been various international debates over how to manage the quality and supply of freshwater in ways that protect the least well-off and at the same time promote economic development. Innovations to better manage freshwater resources and respond to shortages – including use of reclaimed wastewater, desalination, and demand-side management that relies on economic incentives offer practical, effective remedies for meeting future demands. However, achieving public acceptance of these innovations requires that we embrace fair, open and transparent decision-making processes in which individuals and groups affected by water decisions can equally participate, and where no important constituency is excluded. Several United Nations’ International Hydrological Program writings on water ethics have tried to address such issues, alluding to ‘victims’ of water crises, such as women, the young and frail, the destitute and national minorities. Moreover, the Dublin Principles of 1992 explicitly recognize the role of women in managing water and all people’s ‘right’ to water (Shonkoff et al. 2009).

There are two major challenges in addressing these issues. The first is lack of consensus among nation-states regarding how to translate a set of codified international principles. As one scholar has noted ‘...there is little evidence of a common normative structure in the form of interstate cooperation (that) has taken across the world’s shared river basins, and there is no compelling evidence that international legal principles are taking on greater depth of meaning or even moving in an identifiable direction (Conca 2006).’

Second, environmental justice claims with regard to water posit contending notions of equity. These include: covenants, categorical imperatives, and environmental stewardship. An example of a global ‘covenant’ for environmental justice and water is the 1948 Universal Declaration of Human Rights, promulgated by the General Assembly in a period of post-war optimism. The declaration enshrined two important principles: (1) the right to marry and have a family and (2) ‘(e)veryone has the right to a standard of living adequate for the health and well-being of himself
and of his family,’ including food, water, clothing, housing and medical care. The Universal Declaration was intended as a ‘proclamation’ of the General Assembly to serve as a ‘common standard of achievement for all peoples and all nations’ which should ‘strive by teaching and education to promote respect for these rights and freedoms and by progressive measures, national and international, to secure their universal and effective recognition and observance, and to promote general welfare (United Nations 1948).’

The categorical imperative, closely identified with the German philosopher Immanuel Kant, posits that a moral decision should not aggrandize our own happiness but be generalizable to all who face a similar situation. An instructive water policy example is the (U.S.) Wild & Scenic Rivers Act which is explicitly predicated upon ‘compensation’ for previous losses of streams that were deemed historically significant, and embraces the principle that the ‘established national policy of dam(s) must be complemented by preserving other…selected rivers’ and avoiding significant future harm to them through adopting a uniform national policy (Kant 1975 ed.; Wild and Scenic Rivers Act 1968). In contrast to covenants, categorical imperatives stress respect for prior promises and commitments, and not merely promoting welfare.

Stewardship predicates that humans are responsible for caring for the environment because our reason gives us the capacity to serve as caretakers of resources. Aldo Leopold and other advocates of the conservationist movement understood and often added another stricture to stewardship: in caring for nature, we also indirectly care for our own welfare. One example applied to water management is afforded by the Endangered Species Act which bars federal agencies from actions that jeopardize water-dependent resources or seriously impairs habitat, and that makes litigable the protection of species (Leopold 1949; Endangered Species Act 1973; Fowler 1993). Because we deal with social equity, environmental issues are not discussed here. 

Are innovations to conserve water fair?

Innovations to conserve water or use less of it are referred to as demand side approaches. They include variable rate systems that charge more for greater volume of water use; and mandatory water-appliance retrofitting or other conservation measures. These may be coupled with direct metering of households where demand is measured at the point of consumer use. Demand-side approaches may burden economically disadvantaged groups by ignoring their ability to pay for water, or forcing them to install high-cost, lower-water using appliances.

In California, introduction of metering in domestic uses has led to water savings of between 20–40% (Hanak et al. 2010). Metering’s impacts vary, however. International accounts are useful, but not definitive for comparison. An Argentine study found that public resistance to metering, including vandalism, protests, and refusal to accept newly-installed meters arose in Salta province, prompted by its introduction at the same time aggressive enforcement of bill payment, increasing block rate prices, and household charges for meter installation began. A larger fear was that meters would not be accurately read and that residents would be charged for excess water usage when, in fact, the culprit was poorly maintained, leaking plumbing systems (Post 2009). In Europe, by contrast, studies suggest that metering has been embraced as a means of increasing reliability (i.e. making leak detection easier) and conservation, particularly in privately operated utilities (Barraqué 1992; Erie 2006). While beyond this paper’s scope, one difference appears to be the role of privatization. In Argentina as in many developing nations privatization is viewed as an effort to commodify water and vertically integrate services. In Europe by contrast, privatization separates water services from planning, control, and regulation (i.e. water services are provided by private vendors, while oversight and regulation are reserved to public organizations including river basin authorities). These differences appear to explain why in the latter, metering is viewed as both equitable and efficient, despite polemics lodged by some critics (e.g. Barlow 2009).

Different jurisdictions may have conflicting goals toward metering – again shown by California experience. Since 2004, state law mandates that new dwellings have meters and that utilities bill at metered rates. Before the law’s passage discretion for reading meters was left to local communities that, in some regions, opposed meters (Hanak et al. 2010, 2011: 111).

Increasing bloc rate (IBR) pricing charges customers more per unit of water used once their volume of use exceeds an average-derived use level (i.e. a ‘conservation base.’) In principle, IBR assumes that the greater one’s income, the greater one’s water use – valid when applied to homeowners who practice widespread outdoor uses (e.g. landscaping, pools). Thus, it appears to be equitable as well as efficient: when introduced, water savings of between 10 and 15% have been reported (Hanak & Davis 2006). However, IBR may not account for ability to pay, especially for those on fixed incomes who, for health reasons, use more water.
Moreover, it may create a political conundrum for water utility districts whose elected boards prefer voluntary as opposed to mandatory measures to conserve water.

IBR is not always practiced in areas that need it. In California, two-thirds of the population of the state’s Southern coastal area pays IBR, and other conservation incentives are fostered by the Metropolitan Water District of Southern California (MWD) which has spent more than $185 million over the last decade encouraging customers to install water efficient appliances, plant drought-resistant landscapes, and reduce overall water use. In Los Angeles, reductions in manufacturing in the early 1990s also reduced per capita use. Overall, the South Coast used nearly 450,000 acre-feet less water in 2005 than a decade earlier, despite having 2 million additional residents. As one study concluded, ‘the temptation is to… change the villain in California water policy from pool-loving residents of the South Coast to the urban and suburban residents of Sacramento, the San Joaquin Valley, and other inland areas. However, the urban sector as a whole accounts for just over 20% of water use in California, and utilities in virtually every region are working to reduce per capita use (Hanak et al. 2010).’

Some 50–60% of residential water use in inland areas of California is for landscaping, while indoor use rises with single family home ownership. As income grows, so do outdoor and indoor demands. The regions where this tends to be true often do not employ IBR but use uniform rates that charge the same amount per gallon (Hanak & Davis 2006; Hanak et al. 2010; Baumann et al. 1997). Moreover, for aesthetic reasons, some communities forbid measures that conserve water through, for example, removing lawns and replacing them with water-saving landscaping. Statewide, IBR, appliance retrofitting, landscape irrigation improvements, and agricultural conservation have reduced water use. In 1980 the state had 25 million people and used some 34 million acre/feet of water. By 2001, the state’s 41 million people used 42 million acre/feet (Freeman 2008: 34).

**Equity dilemmas of conservation**

There is little consensus regarding what makes variable water rates equitable. California exemplifies this problem. A growing literature has focused on water affordability and economic hardship as a means of addressing this issue. Raucher (2004) argues that affordability is subjective and place-specific, revolving around whether low- and fixed income households must sacrifice other needs to pay for water, have access to policies that compensate the added expense, and would suffer greater health risks if the utilities that serve them cannot garner sufficient revenues to improve their environmental performance. A general way of treating affordability – also seen in California – is by comparing average water rate increases against the Consumer Price Index – as Long Beach periodically does – Wattier 2004).

This subjectivity makes it difficult to quantify how affordability affects water use. International data indicate that poorer nations use far less water per capita than do highly developed societies – the U.S. as-a-whole and developing societies rates of use differ from three to over ten times (UNDP 2006). Among U.S. communities and states per capita usage rates, controlling for income, are narrower but discernible. In California, some 24% of households served by Class A water districts (those serving 10,000+ customers) are at or just above the poverty level. Studies indicate these customers face consistent difficulty meeting one or more basic needs, including paying for water. This percentage is comparable for those districts serving fewer customers. Statewide, utilities have adopted numerous low-income assistance measures including sliding income scales with diminishing discounts and free leak repairs (Wilson 2007).

Throughout California, where IBR rates have been adopted or under consideration, equity issues have arisen – most recently in communities in Orange and Los Angeles counties. Customer concerns include: how individual household budgets eligible for ‘conservation’ rates are calculated; skepticism regarding whether increased rates are revenue neutral; whether customers are rewarded for efforts to conserve; the failure of water boards to communicate details of their proposed rate structures – including charges they must pay to the MWD because of losses of imported water from the Delta and elsewhere; and, elected officials’ frustration over the cost of enforcing conservation efforts and the lack of funds for appliance retrofits given tight budgets (Brennan 2009; Webb 2011).

**Re-use, recycling, desalination: environmental justice impacts**

Recycled wastewater use presents several environmental justice challenges. It can reduce needs for imported freshwater, thereby alleviating pressures on supplies belonging to others; and it reduces wastewater-generated pollution by alleviating the need to dispose of ‘dirty’ water in rivers and streams. In considering whether the use of recycled water is fair, it is important to acknowledge the so-called ‘toilet-to-tap’ issue: the perception that people are being asked to
use water that has quite readily been diverted from the wastewater stream and immediately used as tap water (Stephens 2005).

Second, greater reliance on water re-use and wastewater recycling to: enhance and recharge groundwater resources and for prescribed potable and non-potable uses may encourage additional growth in water demands. California surveys find that it is often viewed by people as an indirect subsidy for additional residential and business expansion (Boberg 2005; Groves et al. 2008). And third, while a number of studies going back to the 1970s indicate that potable reuse is safe, doubts have arisen over safeguards. Important to the environmental justice debate is that perceptions of safety are associated with a sense of inclusion in decision-making. In less affluent areas, those communities suffering from ongoing water-related with environmental legacy issues (e.g. abandoned hazardous waste sites, contaminated aquifers) proposals for re-use arouse suspicion and widespread mistrust – even though there is no evidence that these communities are targeted for reuse. A key acceptability issue, discussed in the next section, is how recycled wastewater is actually used.

Desalination produces a difficult set of equity challenges. On the one hand, it remains an expensive, energy-intensive, environmentally risky option that requires some amount of public or taxpayer subsidy to operate profitably. On the other, given that virtually every option for expanding the supply of freshwater (as opposed to reducing its demand) entails some environmental risk and imposes an economic burden on someone, we must be cautious about applying criticisms to desalination that we would not be willing to apply to other supply options.

On a relatively small-scale, desalination has long been practiced on ships at sea and in nuclear submarines – applications that have proved its technical viability. On a larger scale, desalination embraces a broad set of processes that remove salt and other minerals from seawater, brackish water, river water, wastewater, and even treated municipal supplies. Over 12,000 desalination plants in 120 countries currently provide some 14 million m³ of freshwater daily – an amount still less than 1% of the world’s total freshwater consumption.

Because large-scale desalination uses large amounts of energy, it is very costly, especially when compared to the use of freshwater from streams or aquifers – from $1,000–$2,200 per acre-foot, compared to $200 an acre-foot for water from conventional supply sources. This is the principal reason that 75% of the world’s entire desalination capacity is found in the Middle East (mainly Saudi Arabia, Kuwait, Qatar and Bahrain, the United Arab Emirates). The latter is home to the planet’s single largest desalination facility: the Jebel Ali Desalination Plant, phase 2.

Despite the limited application and use of desalination, there are two reasons to resort to desalination in certain applications. One reason is sharply curtailed alternatives. Santa Barbara and Avalon, California – two relatively isolated communities with few viable options for additional supply, have seawater desalination plants for public supply (the latter does not use theirs). Carlsbad, in north San Diego County, is building one. Second, even without the need for additional water supplies, desalination in certain locales is both a necessary and appropriate remediation tool for restoring water quality. Some 30% of the world’s irrigated areas suffer from salinity problems as a result of dissolved minerals settling on soils, and flowing as runoff into streams and rivers, and desalination plants – including one in Yuma, Arizona, have been built precisely to restore this runoff to a quality sufficient to be used on crops (USGS 2010).

Are reuse and desalination fair?

Wastewater re-use faces adverse perceptions regarding its perceived benefits and risks. How advocates address these perceptions is critical to its acceptability and perceived fairness. The ability to frame messages about the technology’s benefits and risks, and to consult relevant stakeholders, directly affects these perceptions (Miller 2006: 67).

In the 1970s California’s Orange County, California Water District (OCWD) built a wastewater purifying plant – WF 21, a reverse osmosis facility – to replenish the region’s aquifer. By the 1990s, population growth made WF21 obsolete, and the OCWD developed the Groundwater Replenishment (GWR) system to provide tertiary wastewater treatment, replenish the aquifer, and provide 20% of potable supply for its service region. GWR produces 70 million gallons of freshwater per day (nearly 62% of northern Orange County’s water supply). Half this volume is distributed to the city of Anaheim, the largest community in the county, where it is percolated into the groundwater basin. The rest is distributed to Huntington Beach and Fountain Valley, where it is injected into special groundwater wells. Project benefits include reducing the need to import and divert freshwater, lessening wastewater-generated pollution, and providing a barrier against saltwater intrusion to the aquifer (Mills et al. 1998). Because the recycled water is pumped and percolated underground, and then drawn from the aquifer for later use – it is effectively ‘mixed’ with virgin water. Coupled with its other benefits
noted above, perceptual concerns regarding drinking recycled waste water are largely abated.

Aware of public opposition to similar efforts in Los Angeles and San Diego, OCWD also undertook a concerted public outreach effort which emphasized a four-pronged engagement and message-framing strategy. First, GWR talks were tailored to the needs, interests, and concerns of various groups. They emphasized the details of system operations, safety, and benefits. Secondly, there were numerous publications – including a brochure and website produced, and a public television documentary that reinforced positive images of the project. Third, the project attracted federal, state, local grants – opened on-time, within budget. Finally, local water laws permitted recycled water uses in appropriate applications, further helping to ensure that treatment costs for non-potable applications would be manageable (OCWD/OCSD partnership 2004).

Survey results elucidate the demographics of public support for recycled wastewater use in other California regions hard-pressed by shortage. A San Diego Institute for Policy Research survey (Nienstedt 2007) found that while 90% of local residents believed water availability is a serious problem, only 44% favored recycling of wastewater as solution. On learning that most of their drinking water is recycled, 63% of residents stated they would favor it, with 28% stating ‘no.’ This survey found that length of residence in the community (newcomers are somewhat more likely to support recycling), and race are important factors in predicting acceptance. Some 43% of Spanish-speaking Latinos strongly support potable reuse, while 50% of English-speaking Latinos do. Support was dramatically lower among Whites, Asian-Americans, and African Americans (20, 10, and 13% ‘strong support,’ respectively. Moreover, 65% of African Americans strongly oppose to its use: the highest percentage of any racial demographic (Nienstedt 2007: 10–11).

To contextualize these results, in the aforementioned Los Angeles case, where local homeowner opposition to recycled wastewater in the San Fernando Valley took the form of a movement against ‘toilet-to-tap,’ the community was largely white, middle class, and comprised of long-term residents – similar to the San Diego survey findings. Interestingly, the latter survey also found that when recycled wastewater is re-used as ‘well water’ (as in GWR), it is more acceptable (Nienstedt 2007: 11).

Desalination prompts another set of environmental justice concerns. While a viable technology for providing additional freshwater, its costs and benefits are un-evenly distributed – making consensus over its application difficult to achieve. A big equity problem is the potential long-term environmental impacts on other media – air quality and global climate in particular. Current desalination methods consume around 14 kWh of energy for every 1,000 gallons of desalinated water produced. Because the most common desalination energy sources are fossil fuels, air pollution and carbon dioxide emissions are important externalities. Ironically, one implication is that a technology to augment freshwater may adversely affect long term climate trends leading, in turn, to reductions in freshwater.

Desalination plants also consume large amounts of land and damage marine organisms through saline water intake. Heavily concentrated brine waste may kill marine organisms in the area into which it is discharged, and the discharge is usually warmer than the surrounding water. This can negatively impact the delicate balance of marine habitats (The Cost of Desalination 2010). In Carlsbad, California, a desalination plan proposed by Poseidon Industries exemplifies these and other equity tradeoffs. Not only is the proposed plant energy-intensive (it will use some 33 MW) but the company building it is seeking funding from the Metropolitan Water District – raising questions about the fairness of a public entity subsidizing a private-for-profit project (Pitzer 2009). As with recycling, survey research underscores the importance of local perceptions: the closer one resides to and likely benefits from, the proposed plant, the stronger the support for it. Whites, Spanish-speaking Hispanics, and those who trust government less also tend to support desalination (Nienstedt 2007: 8).

Toward an equitable water future – ‘old’ and ‘new’ notions of environmental justice

Traditionally, environmental justice (EJ) advocates have been concerned with issues such as hazardous and toxic waste storage, disposal, and incineration and their impacts upon racial minorities, the poor, and women. Impacts including land contamination, air- or water-borne pollution, and long-term, intergenerational health hazards that are site-specific and community-centered tend to fall disproportionately upon these groups. In California, this traditional EJ paradigm remains very important for water, particularly in places such as the Central Valley where low income communities of color often lack clean water or access to improvements to address toxic contamination, the desire for inclusive participation in decisions regardless of income or race, and activities that subject indigenous peoples to cultural annihilation (e.g. dam-building and flooding ancestral lands – Environmental Justice Coalition 2005: 10).
By contrast, water conservation, IBR pricing, reuse, and desalination do not easily fit into this traditional framework for two reasons. First, the perceived benefits and risks from these innovations are socio-economically cross-cutting. While IBR and metering mostly affect lower-income communities, recycled water and desalination are perceived as negatively impacting middle class white communities as well as under-represented populations. Second, impacts from all these innovations are perceived as long-term and chronic, rather than short-term and acute (e.g., community stigma, diversion of ‘hard earned tax dollars’ to special interests). Thus, they tend not to produce the types of political mobilization associated with hazardous waste or contaminated water supplies – protagonists express concerns through the media or via surveys and polls (Table 1).

To say that these ‘newer’ conflicts are low intensity, however, is not to ignore that they represent a growing source of dispute.

The traditional and newer idiom for environmental justice and water share a common denominator: the need for fair, open and transparent decision-making processes in which all groups affected by water decisions can equally participate, and where no relevant constituency is excluded. Such processes, we argue, must embrace three characteristics. First, they must be proactive. One cannot wait for public concerns to arise. Decision-makers must reach out to disaffected groups to inform them of the reasons these technologies are being endorsed, to educate and inform them, and to elicit and respond to their concerns. In regards to the three models of environmental justice discussed earlier, we can think of this first characteristic as corresponding to the covenantal tradition: everyone is presumed to have a basic right to water and to information about its quality.

Second, these innovations require that attention be paid to compensating those less able to afford the distributional burdens of IBR, appliance retrofits, or even leak repair. While IBR and metering’s benefits make good sense, measures are needed to assist special populations in their adoption. Implementation should be calibrated according to affordability. As we have seen, affordability is affected by factors over which the poor may have little control – such as special health needs and care for small children or the elderly. These conditions warrant a kind of categorical imperative – counter-balancing for economic hardship with low-income assistance measures, for example, and being more accessible to under-represented groups in scheduling and conducting meetings and accommodating the needs of audiences who lack the technical skill to decipher environmental documents (Environmental Justice Coalition 2005: 61–63).

Third, potable water innovations like wastewater re-use and desalination could benefit from national-level water-supply certification standards that assure protection of in-stream flow and health safeguards. These would affirm that their advantages are independently validated, and strongly resonate with the notion of stewardship (Miller 2006). All three must be embraced to overcome public inhibitions toward adopting these innovations.

| Table 1 | ‘New’ and ‘Old’ notions of environmental justice and water |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| Burden of impact | Characterization of hazard | Nature of conflict | Examples of disputes |
| Traditional notion of environmental justice & water | Risk of water problems potentially high- consequence; fall on poor, women, minorities | Threats to human health/well-being – /toxic waste, reduced in-stream flow; remediation | High-intensity; social protest, violent demonstrations; acute, short term impacts salient | Dam-building/re-locating populations; inter-basin diversion; massive pollution spills |
| Newer idiom for environmental justice & water | Risk of water problems potentially high consequence/high uncertainty; e.g., climate change | Broader welfare issues at stake – cost, affordability, access, actions to address/repair legacy important | Lower-intensity; social protest may occur but problems viewed as long-term & chronic | Waste-water re-use; desalination; involuntary conservation measures; privatizing supply |

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