

Justice and moral economies in “Modular, Adaptive, and Decentralized” (MAD) water systems

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ABSTRACT

“MAD Water” systems (modular, adaptive, decentralized infrastructures) will expand to meet human water needs under future climate change, migration, and urbanization scenarios. Yet the use of MAD systems often undermines water justice. Here we argue that identifying and analyzing *moral economies for water* can allow scholars to understand—and possibly predict—when and why justice in MAD water systems is upheld, breaks down, or becomes unstable. Moral economies are institutional arrangements in which shared understandings of justice normatively regulate the distribution and exchange of basic resources. We review the moral economies concept, explain an operational framework for analyzing moral economies, and use this framework to illustrate how moral economies function to uphold justice (or not) within three types of MAD water systems today: water sharing arrangements, informal water vending markets, and small-scale water commons. We show that when moral economies are embedded and operating successfully in MAD water systems, they can create check-and-balance mechanisms against injustice. But when moral economies are absent or failing, water injustices often prevail. The moral economies framework therefore provides not only a tool for theory building and analysis, but also a possible language and pathway for communities to organize for justice. We conclude by outlining key areas for future research.

1. Introduction

It is now clear that modular, adaptable, and decentralized (MAD) water infrastructures—as alternatives to fixed, centralized ones—will expand to meet human water needs in the 21st century [1,2]. Examples are diverse and include household rainwater harvesting, wells, modular treatments like household filtration, water sharing systems, and mobile water vending. While centralized and universally accessible piped water networks may be the gold standard for water delivery, our reality is that MAD water infrastructures (1) are already here and used by the majority

of people in the world, and (2) will only become increasingly necessary as we forge ahead into the immanent era of climate change.

Yet, a major concern for this future is that the deployment and use of MAD infrastructures can pose significant threats to water justice [1,2]. By water justice, we mean people’s notions of equity and fairness around the distribution, procedures, and interactions of water access and management [3–6]. Although MAD water infrastructures provide water access for many people and communities, existing MAD systems are often experienced as profoundly unjust [7–17]. For instance, community-based water management (CBWM) policies (those that

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decentralize and shift water management responsibility from state actors to local communities) often place significant burdens on poor and marginalized populations who lack the necessary resources and infrastructures to manage and maintain their water systems [7,18–20]. Another salient example: the billions of people who rely on mobile water vendors pay 4–30 times the price for water per unit compared to people who buy their water from piped municipal water networks [21–23]. And yet another: individuals who turn to borrowing and sharing water to manage water insecurity [24,25] report greater levels of conflict, shame, anger, and depression [26,27].

This evidence suggests that relying on MAD water systems in haphazard or nonstrategic ways will disproportionately burden politically marginalized and low-income communities. It is also likely to result in uncertainty and distress for such communities as they try to navigate their water needs. In a MAD water future, prioritizing justice as an indicator of success is therefore essential to ensure that these systems can and will help us to deliver the human right to water – not only as a moral and ethical imperative [1], but also because (in)justice has major impacts on human health and well-being [7,24,26,28–30].

How then can we ensure that deployment and use of MAD water infrastructures can uphold water justice? Here, we argue that *moral economies* for water provide one approach for analyzing, and potentially enacting, justice in a MAD water future. We begin with relevant background on the concept of moral economies and discuss how communities have historically relied on moral economies to normatively regulate social behaviors that uphold justice in the context of resource insecurity and inequality. We then explain a recently developed operational framework for moral economies that scholars can use to analyze (in)justices in resource systems. Next, we use this framework to illustrate three examples of how moral economies function in existing MAD water systems today, highlighting when they succeed vs. when they fail to enact water justice. We then, with a view to future-oriented water scholarship, identify five key issues that require further research to advance scholarship on moral economies and water justice in an increasingly MAD-water world.

2. Background to moral economy research

A moral economy is a norm-based social institution in which people's shared understandings of justice shape the distribution and exchange of vital resources [31]. In an idealized moral economy, community members leverage shared ideas of justice (e.g., a morally understood right to subsistence and survival) to normatively regulate who gets basic resources and at what cost. In many cases, this involves demanding increased responsibility and accountability from elites (or those with greater wealth, power, and/or resources) to help provide resource access for those of lesser means [32–37]. Elites are socially obligated to fulfill those claims and face social pressures and repercussions for failing to do so, including shaming, gossip, social snubbing, public denunciation, boycotts, and/or rebellions. This balance of social forces means that elite and resource rich people are pressured to adhere to the normatively expected practices (e.g., price regulation, sharing and gifting of resources, donating labor inputs, etc.) that ensure adequate resource access for those in need. In this idealized state, moral economies (a) create a buffer against resource insecurity for the poorest and most vulnerable members of a community, and (b) uphold communal notions of justice that can help to facilitate social stability, especially in contexts of inequality [31,32,38].

This conceptual model of a moral economy was first described in the academic literature in the 1970s by historian E.P. Thompson [35] and political scientist James Scott [37]. Thompson outlined how 18th C. English peasants mobilized a morally understood right to subsistence, and various tactics of social pressure (including boycotts and blockades), to ensure that merchants and landlords maintained fair and affordable prices for grain (their basic food source). Scott [37] built on Thompson's work, illustrating how moral economies in 20th century Southeast Asian

peasant communities instigated social systems of risk redistribution: guided by a morally understood right to subsistence, peasants pressured local elites (via labor stoppages and local rebellions) to guarantee them the provision of staple foods in the event of crop failure. Combined, Thompson and Scott's work powerfully explained how norms of justice regulated economic activity in precapitalist economies.

Over the past 50 years, scholars built on Thompson and Scott's ideas to demonstrate that, even within our globalized capitalist economy, moral economies continue to operate around the world. In hunter-gather communities, for instance, ritualized and spontaneous food sharing practices (and associated pressures to participate in such practices) support shared beliefs that all community members have the right to live and, by proxy, the right to food [39,40]. Within contemporary pastoralist groups, moral economies structure broad networks of resource sharing—in which people demand basic goods from those who have—that ensure survival and facilitate social stability under economic and environmental pressures [38,41–43]. In industrialized urban contexts, people regularly make material demands (e.g., asking for food or money) on social ties they deem to be better off or in positions to offer help and support; in many communities, such demands are seen as just and fair given shared understandings of a moral obligation to help kith and kin in need [44–49]. Collectively, this body of scholarship indicates that moral economies are a widely used norm-based institutional arrangement that, when operating well, enables people to enact justice and regulate resource distribution in contexts of resource insecurities and inequalities.

Twenty years ago, a nascent literature emerged on moral economies for water, suggesting that as water becomes increasingly insecure, moral economies are becoming increasingly central to water distribution [38,50–55]. This literature also indicates that moral economies can offer insights into the ways that communities normatively manage water according to localized notions of fairness, justice, and shared social struggle [50,53,56–58]. In the following sections, we explain a recently developed operational framework for recognizing and analyzing moral economies for water, and we explain how this framework can be used by scholars to analyze (in)justice within MAD water systems.

3. A framework for moral economies for water

Moral economies contain three fundamental elements: (1) shared understandings of justice, (2) normative economic practices, and (3) mechanism of social pressure (Fig. 1) [31]. These three elements instigate and reinforce one another. For example, in moral economies for water specifically, people's shared notions of water justice undergird their normative economic practices for the exchange and distribution of water (such as gifting water or keeping price points for water affordable). These practices serve to bolster, support, and reinforce people's existing notions of water justice. People also use mechanisms of social pressure (e.g., gossip, shaming, snubbing, protest) to compel others to adhere to the normatively expected practices. The act of applying social pressure to those who try to evade normative practices, again, reinforces the shared notions of water justice.

The dynamic interactions between these three elements of a moral economy illustrate that moral economies are not motivated by benevolence alone and do not inherently create equity. Rather, they largely rely on conflict and social struggle—or the threat of conflict and social struggle—in attempts to cultivate, uphold, and enforce water justice, most often within contexts of social and economic inequality [31–34,36,59]. It is therefore useful to understand that any given moral economy for water may exist in one of at least 4 idealized states (Fig. 2): (1) balanced struggle, (2) intensified reaction, (3) mass revolt, (4) collapse and dissolution [31].

In a state of *balanced struggle*, a moral economy is operating well to enact and uphold notions of justice and enable resource access for those in need [31]. People (aware of social pressures on them) adhere to commonly understood notions of justice; they regularly and predictably

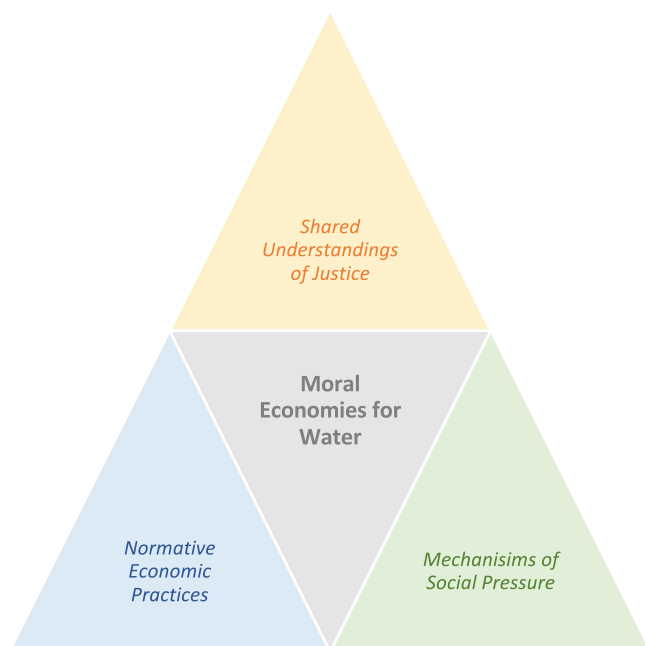


Fig. 1. Three elements of moral economies [31].

engage in expected economic practices that support those notions of justice; these actions ensure access vital resource access and uphold a sense of justice within the community.

In a state of *intensified reaction*, a moral economy may still be operating in ways that uphold justice and enable resources access, but these processes happen as the result of significant social struggle [31]. People may rebuff or refuse to uphold the normatively expected economic practices. Others thus enact social pressure mechanisms. These pressure mechanisms may be enough to persuade the refuser to acquiesce, or many prevent others from refusing in a similar fashion. In this case, the system may tip back into a state of balanced struggle. But if the social pressure is not sufficient to reinstate normative economic behaviors, the system may instead tip into a state of mass revolt.

In a state of *mass revolt*, a moral economy is failing to uphold justice and enable resource access [31]. The usual mechanisms of social pressure repeatedly fail; expected economic behaviors are repeatedly rebuffed; and people's notions of justice are repeatedly undermined. Riots, large-scale protests, and mass-revolts may occur as a last-ditch effort to reinstate the moral economy. Sometimes these social movements and large-scale demonstrates are sufficient to bring the moral economy back into a state of balanced struggle or intensified reaction. Under other circumstances, the moral economy may tip into a state of collapse and dissolution.

In a state of *collapse and dissolution*, a moral economy is no longer functioning [31]. Shared understandings of justice are weak or misaligned; normative economic practices are absent, unpredictable, or easily refused; mechanisms of social pressure are absent or disorganized. In essence, the moral economy no longer cultivates, upholds, or enforces justice.

Understanding how moral economies for water shift and change over time through these various states—instigated by social, political, and environmental forces—enables us to see how they may operate within MAD water systems to uphold (or fail to uphold) water justice.

4. Moral economies in current MAD water systems

Moral economies are present in a variety of MAD water systems today. Here we focus on applying the concept to three: water sharing systems, informal water markets, and small-scale water commons.

4.1. Interhousehold water sharing

Water sharing—the non-market exchange of privately held water between households—is a ubiquitous adaptive response in water insecure environments and arguably one of the most common examples of MAD water around the world [2,25].¹ A recent study of 21 water insecure sites in low- and middle-income countries found that people in all sites engaged in water sharing practices, and 44 % of the total study population reported that they borrowed water at least once a month [24]. However, another recent study also found that households who engaged in water sharing report significantly higher levels of shame, conflict, and anger [33]. Some ethnographic accounts of water sharing, in which neighbors beg one another for water and plead for the sake of their children, provide poignant examples of how this practice can perpetuate injustice [60]. Nonetheless, other studies indicate that the act of sharing water can engender senses of solidarity, uphold and reinforce notions of water justice, and lead to little distress [61–64].

The presence and functioning of moral economies may help explain these drastically different experiences. Several studies on water sharing in Islamic communities note strongly embedded social systems in which sharing water upholds a communal sense of water justice. In these communities, a Hadith compels Muslims to share surplus water with those in need [7,65–67]. For instance, in Khartoum, Sudan, people explained the norm, “to give water whenever you are asked,” because, “Water is a necessary thing for life” [66]. People without piped water regularly ask for it from neighbors with private tap stands. Neighbors with tap stands predictably oblige, to some extent, because refusing water to neighbors may result in shaming and gossip, but also because giving water provides significant social and political capital that they can call upon later. This system illustrates a moral economy in balanced struggle. A shared sense of water justice compels acts of sharing water; a threat of social sanctions ensures water is given to those in need. Here, benefits of sharing water (the accrual of prestige and social capital) provide additional incentives to elites to acquiesce to the moral economy. Collectively, this system upholds and reinforces communal notions of water justice and protects the most vulnerable from water insecurity [65].

Other cases of water sharing illustrate how moral economies in states of collapse and dissolution can undermine justice and increase distress. In informal settlements of peri-urban Bolivia—where households are not connected to piped water networks and rely on purchasing water from mobile vendors—Wutich [55] found that water sharing between households was a common practice. Residents noted the importance of sharing water generally, referencing the refrain of the Bolivian water war, “water is life,” in addition to their Christian obligations to provide charity to those in need. Yet, many residents nonetheless reported that their neighbors frequently refused their requests for water, and the indiscriminate charity norm meant there was no framework for prioritizing social obligations. Wutich observed that when refusals occurred, residents had very little leverage or recourse to pressure their neighbors into acquiescing to their requests. Often, these refusals occurred because water was so scarce that even better-off households (who had large storage tanks) received so many requests that they could not acquiesce to everyone. These findings led Wutich [55] to conclude that while a moral economy was present, the indiscriminate charity norm combined with limited mechanisms of social pressure, in extreme conditions of scarcity, meant that it was weak and unpredictable, creating significant emotional distress [68].

¹ See [125] for a detailed explanation of human behavioral adaptations to environmental change, and [126] for explanations of human behavioral adaptations to food and water insecurity, specifically.

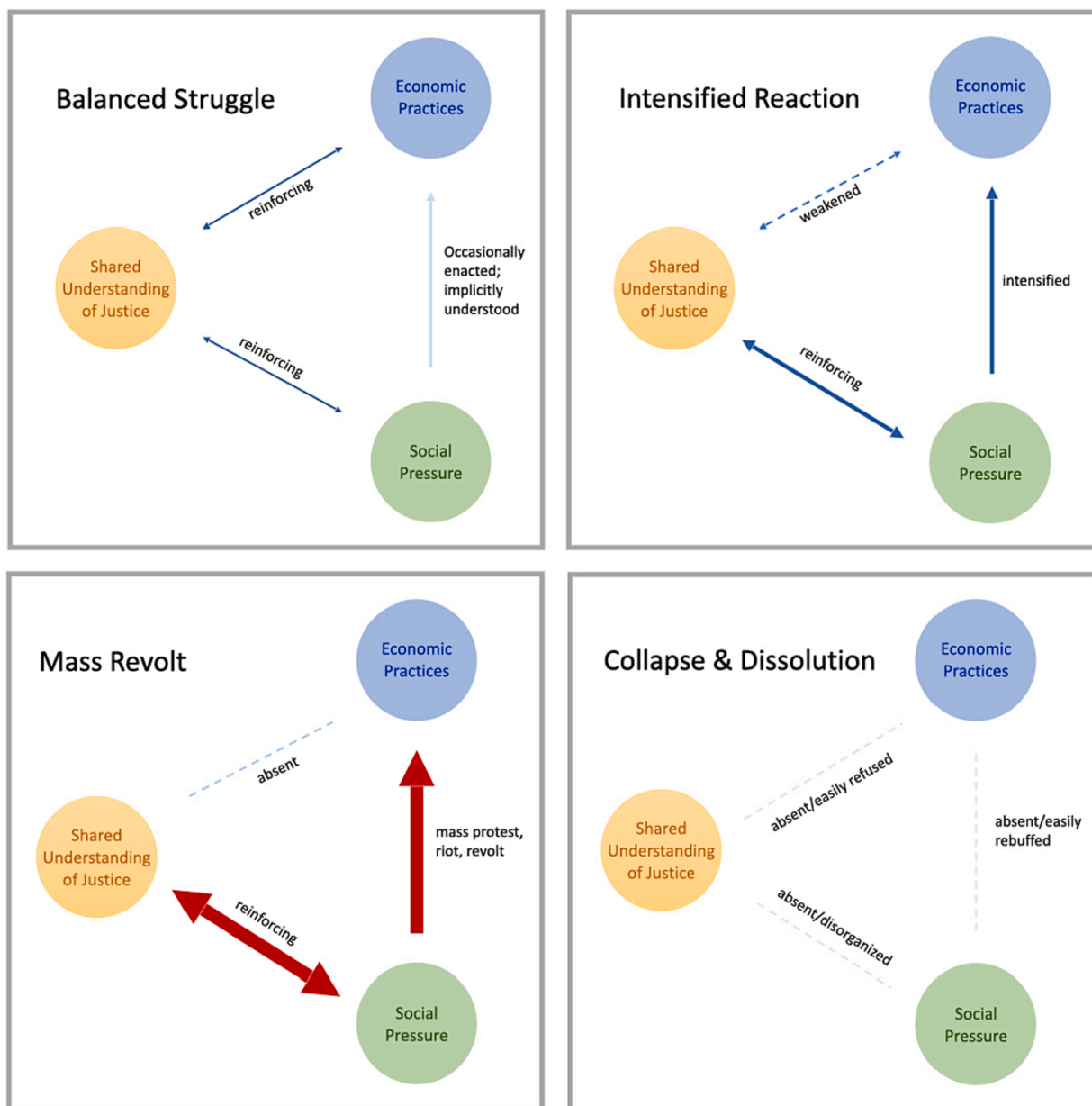


Fig. 2. Moral economies in four idealized states [31].

4.2. Informal water vending markets

For the billions of people around the world who lack access to piped water infrastructure, water vendors have filled the gap. Water vending markets included fixed points (e.g. kiosks and water ATMs) and also mobile vendors who informally sell water in barrels, buckets, sachets, and bottles via trucks, carts, and bicycles [69]. These avenues are often the primary way that households provision water when they are not connected to piped water infrastructure [48,58,70–77].

But informal water vending markets have the potential to undermine three types of water justice: distributive justice (fairness in the quantity and quality of water); procedural justice (fairness in processes of water delivery and distribution); and interactional justice (fairness within the relationships between water vendors and buyers) [6,23,33,74,78]. For instance, the higher delivery costs lead to higher prices per unit compared to piped water [23,69,70,79]. Unpredictable delivery schedules can cause wait times and inconvenience. Tankers have often been found to supply inferior quality water, leading to disease outbreaks

[80,81]. And water sales driven by profit motives can skew services to communities where consumers are willing and able to buy water in larger quantities [82,83]. Nonetheless, the expense and logistical challenges of building, extending, upgrading, and maintaining piped water networks means that mobile water vending is likely to become increasingly prevalent in the coming century [2,22,84,85].

Nascent research, however, demonstrates that when moral economies for water are present and operating in balanced or intensified states, communities may be able to self-regulate water vending markets in ways that uphold water justice. For instance, in Bolivia, groups of unionized water vendors—who are themselves residents of the water insecure communities they serve—view themselves as community-based advocates for their clients’ human right to water [82]. Explaining that “water is life,” (a shared notion of justice) unionized vendors embed an Indigenous practice known as a *yapa* into water sales that gives an extra gift of water (and lowers the price) for regular customers; they meet regularly to ensure standardized, yet affordable, prices; and they collaborate to evenly distribute sales routes (normative economic

practices). These practices are kept in check via the union: if a union member charges higher prices, or deviates from agreed upon routes and schedules, they face sanctions within the union (mechanism of social pressure). Regular clients, who build patron-client relationships with specific vendors, report a shared sense of solidarity and justice. Non-unionized vendors, on the other hand, operate independently with no social system to which they are accountable. These *pirata* (“pirate”) vendors reported higher prices, intermittent *yapa* practices, and unpredictable delivery schedules – practices that clients view as unjust and distressing (*ibid*).

Other forms of informal water markets also illustrate ways that moral economies for water can uphold and reinforce water justice. In Mozambique, neighbors regularly re-sell water to one another at cost; embedded local norms prohibit profiting on such sales [66]. In Mexico and South Africa, plumbers and technicians in informal settlements often agree to install illegal connections to municipal water networks at non-competitive rates in order to provide community water access [63,64,86].

Collectively, these cases provide examples of informal markets in which normative beliefs in a right to water facilitate practices that keep water prices affordable and water distribution seen as fair. While much more research is needed to understand the specific conditions that facilitate and enable moral economies to function within informal markets (vs. when they are undermined, collapse, and fail), these cases illustrate points of possibility and call for further investigation.

4.3. Small-scale water commons

Water sharing systems and informal water markets exemplify MAD water systems focused on privately held water. However, water is often a common-pool resource that is collectively managed at the source [38,87–89]. Scholars in the interdisciplinary field of common-pool resource governance studies have identified the diverse institutions governing access, withdrawal and use of water for a range of purposes [90,91]. Despite their diversity, the institutions governing CPRs exhibit the importance of recurring features for successful commons management, including setting boundaries around both the resource and those with access to it, participation, rights to self-organize, community monitoring, mechanisms to resolve conflicts, and sanctions [90,92–94]. Yet, institutional scholars acknowledge that these principles are fundamentally rooted in the ability to exclude key groups. The processes of establishing and enforcing boundaries around shared resources highlight the increasing need to scrutinize the power dynamics within CPR institutions, and illustrate how CPR institutions can deepen inequality [95–97]. Just because a water commons can be successfully maintained does not mean that it is necessarily experienced as just and fair by those who rely on it, or for those who are shut out.

Twenty years ago, Paul Trawick [53] linked institutional theory with moral economy research, noting that moral economies for water facilitated the management of small-scale irrigation commons in the Andes. He observed that farmers—who commonly spoke of the moral right all households had to access the means of subsistence—collectively redistributed irrigation water to ensure proportional allotments. Later, he and colleagues found that similar moral economies for irrigation water occurred in Spain, likely evolving from earlier Islamic systems of water management [54]. By drawing on Thompson and Scott’s moral economy model, Trawick highlighted the central importance of the shared notions of water justice that underpinned the normative actions that enabled the successful management of a water commons. Importantly, the multi-sited nature of Trawick and colleagues’ work indicates that moral economies likely evolved independently, in different regions of the world, as a means to regulate collective action problems [54,98].

Trawick and colleagues’ work illustrated how moral economies—in a state of balanced struggle—can enable bounded communities to successfully manage water CPRs in ways that uphold and reinforce communal notions of justice. But understanding the ways moral

economies exist in various states illuminates the diverse norms, behaviors, and means of social pressure that people can mobilize to *resist* the expropriation and privatization of water commons around the world, or to normatively regulate the boundaries and mechanisms that govern common pool water resources.

In rural India, for instance, Drew [51] documented how the encroachment of a multinational corporation’s operations on communally-owned lands exacerbated public outrage when shared groundwaters were depleted by the corporation’s water extraction and bottling practices. In response, villagers deployed various means of public demonstration and resistance—including fasts, protests songs, opposition chants, and the distribution of information pamphlets—to shame public officials into protecting rural water supplies from contamination by the high-profile multinational. Motivated by Gandhian notions of a rural right to subsistence (and a right to the water necessary to facilitate that subsistence), villagers successfully lobbied for the plant’s closure and the protection of their water ways. This account, along with similar examples of social movements in Italy [99], China [52], Bolivia [100], Senegal [101], South Africa [102], the U.S. [103], and Indigenous nations [104,105] demonstrate how people can collectively mobilize notions of water justice when moral economies are violated and use means of mass resistance to bring moral economies into balance.

5. Future research directions for moral economies in a MAD water world

These cases show how moral economies have the potential to create check-and-balance mechanisms against injustice when they are embedded within informal MAD water systems and operating in a balanced state. Major questions remain, however: Can informal moral economies for water be integrated with formalized public policy approaches to create hybrid MAD water systems? How do structural factors such as agency, power, racism, colonialism, nepotism, sexism, etc. shape normative ideas, behaviors, and capacities for enacting social pressure? What impacts may these factors have on the development and functioning of moral economies for water and their ability to enact and uphold water justice? Below, we outline five key issues that require attention for answering these questions and advancing scholarship on moral economies and water justice in a MAD water future.

5.1. Boundaries

As norm-based institutions, moral economies operate within communities, but community boundaries are political, not easily determined, and easily manipulated to justify exclusion and injustice [95,106–109]. The presence of a moral economy for water in balanced struggle only means that water justice is being upheld for those within the community who share those notions of justice. Future research on moral economies must attend to ways that communities are defined, how community boundaries are managed and maintained, how individuals navigate those boundaries, and especially the role of power (and potentially injustice) in all of these processes.

5.2. Heterogeneity

Moral economies rely on shared norms and values. Competing cultural values and power dynamics over the constructions of justice norms in moral economies is severely understudied. Future research must examine ways that cultural heterogeneity and community-level power dynamics influence and structure peoples’ understandings of justice [96,110]. For example, recent moral economy scholarship highlights ways that elected officials use public marketing campaigns to shift public perceptions on the acceptability of paying for water [111].

5.3. Scalability & social distance

Many, but not all, informal resource systems prioritize social obligations according to social distance [112]. Evidence thus far indicates that moral economies typically function well in small, face-to-face, and culturally homogeneous communities with tightly shared norms (e.g., [113,114]). As communities become larger, culturally heterogeneous, and rely on people to enter agreements and exchanges with others to which they have weak or absent social ties, moral economies may be more easily challenged, rebuffed, and ignored [39,40,112] – all of which have the potential to tip moral economies into states of mass revolt and/or collapse and dissolution. Dynamics of social distance have not yet been studied in moral economies. However, nascent scholarship suggests ways that norms of justice can be cultivated at scale via large-scale social movements and other mass mobilizations [100,115]. The institutional scholarship on nesting arrangements [90] and socioecological systems scholarship on panarchy [116] are key to understanding ways that moral economies may scale (or fail to scale), including at regional, national, and international levels.

5.4. Formalization

Institutions exist along a continuum of formalization [117,118]. “Formal,” institutions are codified within legal governance systems. “Informal” institutions, in contrast, are norm-based and operate outside of legally codified governance frameworks [90,119,120].² Scholars note the many advantages of formalizing institutional rules, including more transparency in sanctions and clearer procedures for governance [90]. But moral economies typically exist as informal, norm-based systems. Greater formalization of moral economies may be tempting to ensure transparency and efficiency. But to date, no research has been conducted on how formalization may affect the outcomes of moral economies. For example, formalization may prevent the norms that constitute moral economies from evolving in accordance to social, political, and environmental circumstances.

5.5. Scarcity

Moral economies for water may not work under conditions of extreme water scarcity, even if the whole community shares norms and practices of a moral economy in times of less severe scarcity [55]. Research on famines, for example, notes that moral economies typically collapse when entire communities are resource starved because there simply are not enough resources to share and/or redistribute [37,121]. In contexts of extreme scarcity, enforcement of a moral economy may increase social unrest, especially if everyone is experiencing similarly extreme scarcity. Decades of research shows that extreme scarcity of food and water is more often the result of political processes than natural events [122], and shows why it is likely dangerous to assume that communities can govern MAD water systems on their own with few resources or larger systems of institutional support [7,8,19,38,95]. But more research is needed to understand the environmental or material limits at which moral economies can operate [123].

6. Conclusion

Moral economies are used in diverse cultural contexts to cultivate and normatively uphold and enforce local understandings of justice in resource systems. Through cases in the ethnographic literature, we have

² In reality, few institutions are purely “formal” or purely “informal,” but rather depend on a mix of both [117,118,127]. For example, many formally recognized and regulated businesses rely heavily on informal exchanges and labor arrangements that operate “under the table” and outside of state purview [44].

shown how the moral economies framework can help us to (1) understand when and why water justice is, or is not, being upheld within a MAD water system and (2) to predict and explain cases in which efforts to achieve water justice succeed or fail.

It is important to remember, however, that the moral economies framework is a simplified model of human behavior. In reality, the norms and actions that constitute moral economies are messy, complex, and vary according to diverse social, political, and environmental circumstances. Moral economies (as institutional arrangements) are not conflict-free utopias or benevolent systems of altruism. Like all institutions in real-world contexts, moral economies can manifest in patchy and unpredictable ways and may sometimes work to enact and uphold one form of justice while simultaneously entrenching other forms of injustice (cf. [124]).

The point we make here is that when moral economies for water operate in a state of balanced struggle, they may create a check-and-balance system of normative behaviors that uphold people’s notions of water justice. But when moral economies for water are non-existent or operating in states of intensified reaction, revolt, or collapse and dissolution, water injustices may prevail. As such, the moral economies framework provides not only a tool for analysis, but also a possible language and pathway forward toward organizing for water justice in MAD water systems. Ultimately, we see the moral economies framework as a nascent tool for water scholarship and practice, with much space for novel case-building, empirical analysis, and theorization, especially in the MAD water future that lies ahead.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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