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# POLICY ANALYSIS OF YEMEN'S WATER CRISIS



BY RACHEL LANG



The Center for  
Industrial Development

# NOTE FROM THE PRESIDENT

Water management is a crucial policy area for agriculture. Regional supply varies around the world and therefore can become a limiting factor in agricultural—and thus economic—development. No where is this more pertinent than Yemen. For that reason, we are proud to present the first report in our work on agriculture.

This report contains a policy analysis of Yemen's water crisis including historical perspective and policy recommendations. It will be followed by a separate report with an analysis of specific demand and supply side management policies that can be applied in Yemen and other countries. As always, we hope you enjoy and share this report, and we look forward to expanding our work in agricultural development.

Sincerely,



Yianni Nikolaou  
Founder and President



The Center for  
Industrial Development

# INTRODUCTION

Life on Earth is wholly dependent on water.<sup>1</sup> The often-underappreciated natural resource comprises approximately two thirds of an adult human by weight and represents the most abundant material in the protoplasm of all plant and animal life. Without replenishment of internal water, humans cannot endure for more than a week. The resource's importance doesn't end with biological necessity; it is also crucial to business and industry. It thus sustains the health, food production and economic development of human populations.<sup>2</sup> Yet, despite its status as the world's second most important natural resource — after only the air we breathe — water is an undervalued and under-protected resource.

Although water is replenished by rainfall and is thus considered a renewable resource, its availability is finite with regard to regional supply available per unit of time.<sup>3</sup> As human populations and economies expand, the demand for freshwater increases accordingly. The ensuing water shortages not only diminish the food supply for humans, but also gravely threaten the biodiversity of fragile ecosystems, facilitate the spread of diseases and reduce overall water quality.<sup>4</sup> Moreover, water shortages are often accompanied, or confounded, by difficulties in fairly allocating the limited supply available, which can prompt conflict between peoples and among competing industrial, agricultural and urban sectors.

Nowhere is the issue of water scarcity more acute than in the Middle East and North Africa (MENA). The region contains 6.3 percent of the world's population but just 1.4 percent of its renewable fresh water.<sup>5</sup> Per capita freshwater supplies are well below the water poverty line of 1,000 cubic meters per year.<sup>6</sup> The World Resources Institute classifies the region as under "extremely high stress," signifying that more than 80 percent of the water available for agricultural, domestic and industrial users is withdrawn each year. Access to water and other shared resources is expected to become yet another source of tension in the region.<sup>7</sup> At best, changes will be necessary. At worst, the Middle East's largest cities will be completely uninhabitable for human life.<sup>8</sup>

While potable water typically accrues the most coverage in the media and attention among non-governmental organizations, it is agriculture that can make or break an already-compromised water supply. An average of 70 percent of the world's limited water resources is allocated for agricultural use each year. In developing countries with some level of industrial activity, this number climbs even higher. In Yemen, for example, 90 percent of the country's scarce water supply is claimed by irrigation for agricultural purposes. Not only does this sector usurp a disproportionately high percentage of resources, but it is under multiple pressures: to satisfy a rapidly growing population, to keep pace with rising per capita food consumption and to reduce the region's high food import expenditure.<sup>9</sup> And as the agricultural sector uses increasing amounts of limited water resources, it does so at the expense of the other sectors vying for access.

<sup>1</sup> Donald B. Aulenbach, "Water — Our Second Most Important Natural Resource," *Boston College Industrial and Commercial Law Review* 9.3 (1968): 535

<sup>2</sup> Farzaneh Roudi-Fahimi, Liz Creel and Roger-Mark De Souza, "Finding the Balance: Population and Water Scarcity in the Middle East and North Africa,"

<sup>3</sup> Population Reference Bureau MENA Policy Brief (2002): 1. .

<sup>4</sup> Roudi-Fahimi, 2.

<sup>5</sup> David Pimentel et al., "Water Resources: Agricultural and Environmental Issues," *BioScience* 54.10 (2004): 909.

<sup>6</sup> Roudi-Fahimi, 1.

<sup>7</sup> "Renewable Internal Freshwater Resources Per Capita," The World Bank World Development Indicators Database, Accessed Sept. 17, 2016, <http://data.worldbank.org/indicator/ER.H2O.INTR.PC?locations=ZQ>.

<sup>8</sup> Lindsey Espinoza Pedraza and Markus Heinrich, "Water Scarcity: Cooperation or Conflict in the Middle East and North Africa?" *Foreign Policy Journal*, Sept. 2, 2016, Accessed Sept. 18, 2016, <http://www.foreignpolicyjournal.com/2016/09/02/water-scarcity-cooperation-or-conflict-in-the-middle-east-and-north-africa/>.

<sup>9</sup> Brandon Miller, "Persian Gulf Heat: It May Become Too Hot for Humans to Survive, Study Warns," *CNN*, October 28, 2015, accessed November 20, 2015, <http://www.cnn.com/2015/10/27/world/persian-gulf-heat-climate-change/>.

<sup>10</sup> George O. Odhiambo, "Water Scarcity in the Arabian Peninsula and Socio-economic Implications," *Applied Water Sciences* (2016): 6-7.

But this weakness can also be a policymaker's best asset; the disproportionately high amount of water spent on the sector means that improvements in agricultural water policy can have an equally disproportionate impact on resource availability. This analysis seeks to do just that. Through a focus on water use in agriculture, this report will examine the conditions and policies that have resulted in the catastrophe that is Yemen's dismal water supply, in order to provide Yemeni policymakers with a set of tangible recommendations on how it can best begin to improve its precarious situation.<sup>10</sup>

## WATER USAGE IN YEMEN

Yemen today has emerged atop the list of the world's most-water starved countries. The 140 m<sup>3</sup> of water per year used by the average Yemeni stands in stark contrast with the 1,250 m<sup>3</sup> of water enjoyed by other individuals in the rest of the similarly water-starved MENA region.<sup>11</sup> To put these figures in context, the global average stands at 2,500 m<sup>3</sup>.<sup>12</sup> This limited water supply is decreasing every year, and, unless drastic measures are taken, the annual water share is expected to plunge to 55 cubic meters per capita by 2030.<sup>13</sup> Other projections reflect a similarly dismal reality. The conflict-ridden nation is exhausting its groundwater aquifers at a higher rate than any other country,<sup>14</sup> and as a result, the water table is dropping six meters each year.<sup>15</sup> In perhaps the most marked symbol of resource demise, the capital city of Sana'a is forecasted to run out of water completely by 2017, becoming the world's first capital to run out of the resource.<sup>16</sup>

Though it may be noteworthy, Yemen's desperate water situation is not new. Water scarcity has long been a serious concern for Yemen and its neighbors in the Arabian Peninsula, owed in large part to the land's natural characteristics. The majority of Yemeni territory is characterized by a climate that is arid (<600 mm annual precipitation) to hyper-arid (<100 mm), produced by the combination of low rainfall and high temperatures.<sup>17</sup> Yemen departs hydraulically from many of its Middle Eastern neighbors in that it boasts no perennial surface water, meaning that its water resources must be stored in groundwater aquifers or obtained from wadis — riverbeds that fill only upon rainfall — and their spate flows. Because wadis are dependent on precipitation, their spates and volumes are markedly uncertain — an uncertainty that only increases given Yemen's highly variable annual rainfall statistics.<sup>18</sup>

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<sup>10</sup> Yemen is in the midst of an 20-month civil war. There are obviously many pressing issues at hand, yet much of Yemen's poverty-driven conflict harks back to water shortages. It is my view that, whatever the result of the conflict (including humanitarian intervention and eventual nation-building), proper water management must be implemented quickly and effectively to construct a long-term solution for the war-torn nation and its struggling population.

<sup>11</sup> Nicole Glass, "The Water Crisis in Yemen: Causes, Consequences and Solutions," *Global Majority E-Journal* 1.1 (2010): 19.

<sup>12</sup> Matthew I. Weiss, "A Perfect Storm: The Causes and Consequences of Severe Water Scarcity, Institutional Breakdown and Conflict in Yemen," *Water International* 40.2 (2015): 251.

<sup>13</sup> Odhiambo.

<sup>14</sup> Odhiambo.

<sup>15</sup> Odhiambo.

<sup>16</sup> Adam Hefez, "How Yemen Chewed Itself Dry," *Foreign Affairs*, July 23, 2013, accessed November 7, 2016,

<https://www.foreignaffairs.com/articles/yemen/2013-07-23/how-yemen-chewed-itself-dry>.

<sup>17</sup> Christopher Ward, *The Water Crisis in Yemen: Managing Extreme Scarcity in the Middle East* (London: I. B. Tauris & Co Ltd., 2015): 7.

<sup>18</sup> Milan Karner, "Water Scarcity and Human Security in Yemen: 'Assessing the Causes and Consequences of Yemen's Water Crisis,'" *Middle East Institute Perspectives* 2 (2014): 8.

<sup>19</sup> Mohammed Al-Eryani, "Yemen's Water Crisis: Understanding the Causes and Designing the Solution," (presented at Yemen's Developmental Present and Future: A Workshop on the Nation's Population, Environment, and Security Challenges, Washington, D.C., May 18, 2011).

Moreover, just over 5 percent of rainfall is captured in streambeds and available for spate diversion and groundwater recharge.<sup>20</sup> Much of this disparity is attributable to the country's climate; low humidity and high temperatures combine to evaporate rain upon impact.<sup>21</sup> This rapid evaporation means that direct recharge of groundwater aquifers in Yemen is very low,<sup>22</sup> a problem exacerbated by the increasing rates of groundwater depletion seen in recent decades.<sup>23</sup> According to the World Bank, the depletion of groundwater reserves is likely to be complete in the next three decades, bringing about a 40% reduction in agricultural output.<sup>24</sup>

Moreover, this natural predisposition towards water shortages has been compounded by increased population growth. Between 1975 and 2010, the Yemeni population skyrocketed from 6 to 23 million.<sup>25</sup> Much of this increase is attributable to refugee flows from neighboring Somalia, from which an estimated 2 million refugees had entered the country by 2012. Despite the outbreak of a major conflict in 2014, Yemen's population has continued to grow, climbing to 27.5 million by 2016.<sup>27</sup> Its 2.6 percent average annual population growth rate stands as among the highest in the world, and its population is expected to double within the next 20 to 25 years, reducing the per capita availability of water to levels well below the minimum demanded to meet domestic requirements alone.<sup>28</sup>

## ORIGINS OF MISMANAGEMENT

Wholly dependent on rainfall for its irrigation purposes, Yemeni agriculture demands a balance between renewable supply and usage, traditionally achieved through a careful and constant effort of local management, evolved systems of rights and responsibilities, appeals to religious laws, and monitoring of springs, spate flows and watersheds.<sup>29</sup> Crucial to this limited but sustainable agricultural production has historically been an intertwined system of community-level water management and large state structures with well-defined roles for state-appointed irrigation officials.<sup>30</sup> Rooted in religious and customary law, communal norms and traditions worked to maintain a balance among various water users and to promote sustainable water resources management.<sup>31</sup> This delicate harmony was shattered with the advent of new technologies allowing for the exploitation of water from deep aquifers, effectively removing the natural constraint that had been imposed upon consumption by annual rainfall.<sup>32</sup>

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<sup>20</sup> Ward, 45.

<sup>21</sup> Ibid, 43.

<sup>22</sup> Ibid, 55.

<sup>23</sup> Odhiambo.

<sup>24</sup> Milen Dyoulgerov, Ana Bucher and Fernanda Zermoglio, *Vulnerability, Risk Reduction, and Adaptation to Climate Change: Yemen*, Global Facility for Disaster Reduction and Recovery (GFDRR), 2011, 7.

<sup>25</sup> "Population Development," United Nations Population Fund, accessed December 4, 2016, <http://yemen.unfpa.org/topics/population-development>.

<sup>26</sup> Craig Giesecke, *Yemen's Water Crisis: Review of Background and Potential Solutions*, Washington, D.C.: USAID Knowledge Services Center, 2012, 2.

<sup>27</sup> "Yemen," United Nations World Statistics Pocketbook, accessed December 1, 2016, <http://data.un.org/CountryProfile.aspx?crName=yemen>.

<sup>28</sup> Odhiambo.

<sup>29</sup> Ariel Dinar, *The Political Economy of Water Pricing Reforms* (New York: Oxford University Press, 2000): 382.

<sup>30</sup> Scott Moore, "Parchedness, Politics, and Power: The State Hydraulic in Yemen," *Journal of Political Ecology* 18 (2011): 42.

<sup>31</sup> Weiss, 257.

<sup>32</sup> P.J.G.J Hellegers, C.J. Perry and Nasser Al-Aulaqi, "Incentives to Reduce Groundwater Consumption in Yemen," *Irrigation and Drainage* 60 (2011): 93.

In the 1960s, the country's modernization process and its accompanying economic, technical and sociopolitical developments brought forth an influx of capital and migrant workers, and with it, modern technology.<sup>33</sup>

The economic changes brought about by modernization induced the rapid development of agricultural technologies (tube wells, tractors, chemical inputs), shifting the country away from its traditional farming practices and water management systems (and balance with its natural resources) and towards the rapid and unchecked exploitation of groundwater resources. This suddenly attainable untapped resource was likened to a subterranean sea among the Yemeni highland communities, considered a Gift of God not unlike the oil wealth with which their Saudi neighbors had been blessed.<sup>34</sup> To the Yemenis, such a gift was meant to be enjoyed, and they embarked upon a path to do just that. The sudden affordability and ubiquity of diesel water pumps, for example, threw tradition out the wayside in favor of profit, rendering existing methods like rainwater harvesting all but obsolete and reducing the appeal of traditional protective measures such as the centuries-old harim mandating that wells must be dug at least 500 meters apart.<sup>35</sup>

In such a system of divide and profit, important systems were created that would have long-reaching consequences for contemporary Yemen and its water-starved population. Prior to the advent of these technologies, customary and Islamic legal provisions had maintained a certain amount of runoff flow for downstream users of flood irrigation areas.<sup>36</sup> This existing system of water rights was efficient, but it could not outlast the capitalistic endeavors put into place after the 1960s. It became the wealthy individuals — and not the government — who, through private capital, financed the proliferation of wells throughout the 1970s.<sup>37</sup> Although water resources were constitutionally proclaimed state property, weak governance gave way to customary law indicating that those who had developed the groundwater wells retained the rights to the water. Local water rights regimes that had evolved from centuries of cooperation were dramatically reorganized to reflect a new system of land tenure characterized by the privatization of common land by tribal communities. Those who owned the wells were free to extract lofty fees from their users and thus to strengthen themselves and their fellow rural elites. This meant that landowners were, and are, able to extract an unlimited volume of water from their aquifers without needing to take into account potential impacts on other landowners.<sup>38</sup>

This developing system of unstable rights led to the usurpation and overexploitation of scarce water resources. When combined with its weak and ineffective government institutions, Yemen's undefined and unstable water rights allowed for the flourishing of illegal wells that contributed to the overexploitation of the country's scarce groundwater. According to estimates from Yemen's former minister of water, 99 percent of all water extracted in the country is done so without license.<sup>40</sup> To compound the problem, state institutions are not only ineffective in preventing such unlawful drilling, but they are often guilty of the illicit activity themselves.

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<sup>33</sup> Dinar, 383.

<sup>34</sup> Kerner, 14.

<sup>35</sup> Vakur Sümer, "The Political-economic Factors Behind Yemen's Water Crisis," Center for Middle Eastern Strategic Studies (ORSAM), August 2, 2016, accessed October 28, 2016, <http://www.orsam.org.tr/index.php/Content/Analiz/4813?s=orsam%7Cenglish>.

<sup>36</sup> Moore, 42.

<sup>37</sup> Dinar, 383.

<sup>38</sup> Moore, 44.

<sup>39</sup> Ahmed Mohamed Alderwish and Wa'el Ishaq Mohamed, "Review of Yemen's Control of Groundwater Extraction Regime: Situation and Options," *International Research Journal of Earth Sciences* 2.3 (2014): 14.

<sup>40</sup> Giesecke, 3.

## ECONOMIC POLICIES LEADING TO MISMANAGEMENT

Although it was the availability of natural capital and the advent of tubewell technology that immediately provided for the rapid expansion of groundwater irrigation in Yemen, the state apparatus pursued a mélange of macroeconomic policies to construct an incentive structure that was favorable to its exploitation.<sup>41</sup> The objectives of these policies were two-fold: to promote the rapid exploitation of groundwater irrigation through a subsidy of its cost while directing benefits towards crucial agricultural interest groups.<sup>42</sup> In doing so, these policies created incentives for water inefficiency and disincentives for conservation.<sup>43</sup> Perhaps most obviously, heavy water subsidies have caused consumption of the resource at unsustainable levels. Low water tariffs imply the lack of incentives for consumers to make any effort to decrease their water usage. Moreover, these subsidies allow farmers to continue producing crops that are neither water efficient nor environmentally sustainable.<sup>44</sup> Not only do these subsidies exacerbate demand, but they also impose a significant burden on a national budget that is already strained.<sup>45</sup>

Water is just part of the inefficiently subsidized resource equation contributing to Yemen's current malaise. During Yemen's agricultural boom of the 1970s, the government heavily subsidized diesel to lower the cost of power and, by extension, the cost of groundwater exploitation.<sup>46</sup> Because diesel represents the major operating cost for groundwater extraction, its subsidy dramatically increased the profitability of irrigation and agriculture, thus encouraging further exploitation of groundwater.<sup>47</sup> In 2009, diesel subsidies seized 25 percent of the national budget — or eight percent of Gross Domestic Product (GDP).<sup>48</sup> In addition, the state gave the agricultural sector credit at interest rates of 9 to 11 percent;<sup>49</sup> if the credit agency had not been subsidized, rates would have skyrocketed up to 60 percent.

Moreover, a disproportionate amount of Yemen's agriculture is devoted to the production of qat, a water-intensive plant whose leaves are harvested into a narcotic consumed by 80% of the Yemeni population.<sup>50</sup> In the period from 1970 to 2000, qat production increased 13-fold. To contextualize just how dramatic of a shift this involved, the country's grape production increased only twofold throughout the same period. Upwards of 70 percent of Yemen's scarce groundwater resources are funneled toward its production — a number that looms even larger when taken alongside the fact that qat represents just 15% of Yemen's cultivated areas.<sup>51</sup> Despite its inefficiencies, there are a number of factors that maintain interest in qat production, including both the barriers to imports that the government implemented to create incentives for its production and the extreme cultural significance the product has assumed.

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<sup>41</sup> Ward, 118.

<sup>42</sup> Moore, 43.

<sup>43</sup> Al-Eryani, 9.

<sup>44</sup> Sandra Postel, *The Last Oasis: Facing Water Security* (London, Worldwatch Institute, 1992): 167.

<sup>45</sup> Ali Ibrahim Al-Moshki, "Economists Agree: Yemen's Economy Risks Collapse," *Yemen Times*, November 6, 2014, accessed December 5, 2016, <http://www.yementimes.com/en/1831/news/4536/Economists-agree-Yemen%E2%80%99s-economy-risks-collapse.htm>.

<sup>46</sup> Hellegers, 94.

<sup>47</sup> Dinar, 383.

<sup>48</sup> *Ibid.*

<sup>49</sup> Dinar, 383-4.

<sup>50</sup> Giesecke, 2.

<sup>51</sup> Hellegers, 94.

With domestic prices considerably higher than they would be in the case of free trade, the qat market is thus entrenched in the actions of governments past — despite the contrary wishes of many policy-makers.<sup>52</sup>

These policies have resulted in a water supply that is priced significantly below its economic cost. Much has been written concerning the importance of properly pricing potable water,<sup>53</sup> yet it is of equal necessity in agriculture, in which “wasteful irrigation constitutes the single largest reservoir within the ‘last oasis.’”<sup>54</sup> Far from an anomaly in this respect, Yemen’s misguided water pricing is reflective of a much larger problem in which governments worldwide fail to price water anywhere near its true value.

Nowhere are these subsidies larger or more pervasive than in the agricultural sector, in which many governments use public funds to construct and operate irrigation systems only to charge farmers extremely low prices for these expensive services.<sup>55</sup> In Yemen, farmers proceeded to sell each other water for US\$0.02 per cubic meter, a dramatic difference from the US\$0.10 required to merely cover the economic costs of its extraction and delivery (with no externalities in play).<sup>56</sup>

## POLICY RECOMMENDATIONS

Yemen today is wrought by a number of problems in addition to water abuse, not the least of which is the 20-month civil war that has killed more than 10,000 people and rendered 80 percent of the Yemeni population in desperate need of humanitarian assistance.<sup>57</sup> Not only are intensified water shortages exacerbated by this strife, but they are also at its roots, as much of the country’s recent militancy has been attributed to an underlying conflict over resources.<sup>58</sup> Moreover, Yemen is marked by a long history of conflict over water resources and of subsequent accommodation of change.<sup>59</sup> It is possible that Yemen’s current misfortune marks not a barrier, but a precursor towards the resolution of historic water abuses and insufficiencies. Whatever the eventual resolution of this conflict, whether it will be the return from exile of President Abdu Rabbu Mansour Hadi, the elevation of a Houthi-Saleh regime, or an external attempt at nation-building, the next government in place must address the country’s longstanding water issues if there is any hope of providing for a future of stability and sustainability.

The necessary reform will involve two simultaneous processes: the government must endeavor to reform existing institutions and establish new ones as well as adapt policies to incentivize water conservation, taking into account the fact that institutions may not yet be strong enough to accommodate the best policy options.

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<sup>52</sup> Glass, 22.

<sup>53</sup> Sheila M. Olmstead, “Water Supply and Poor Communities: What’s Price Got to Do with It?” *Environment: Science and Policy for Sustainable Development* 45 (2003).

<sup>54</sup> Postal, 166.

<sup>55</sup> *Ibid.*

<sup>56</sup> Dinar, 384.

<sup>57</sup> Jeremy M. Sharp, *Yemen: Civil War and Regional Intervention* (CRS Report No. RL43960) (Washington, D.C.: Congressional Research Service, 2016): 2.

<sup>58</sup> Glass, 25.

<sup>59</sup> Ward, 308.

<sup>60</sup> *Ibid.*, 288.

In addressing the institutional vacuum that characterizes much of Yemeni society, officials should challenge the assumption that the state can control groundwater — a notion implicit within the current top-down approach that is incompatible with Yemen's localized water governance context.<sup>60</sup> Adaptive governance techniques should be implemented through the co-management of water resources, allowing for a high level of community engagement and an accurate knowledge of the citizenry's wishes. Yet localized governance is not a panacea; a potential for negative externalities means that communities cannot assume total control of the resource, and water allocation authority must be kept discrete from users. Moreover, shifting economic, technological and institutional paradigms have destroyed Yemeni systems of water rights. As community institutions are strengthened, equal importance must be placed upon the restoration of local water rights systems and the control of drilling. Public rules and regulations can support local community endeavors.

As far as specific policies are concerned, the incentive structure must be reorganized to ensure that it reflects the value of Yemen's scarce water resources. If the experiences of Yemen's regional neighbors are any indication, there is no single solution to Yemen's water crisis. No one technology has yet to be invented that can provide endless amounts of water to satiate an unrestrained demand for its use. Water resource management must assume an integrated approach to target abuses from both ends of the economic equation.

Supply-side measures can work to produce more income for less water through more efficient groundwater irrigation and greater use of groundwater. Yemen's natural terrain and endowments make desalination a poor option for the allocation of scarce Yemeni funds. Should the country's economic situation or the cost-structure of desalination techniques shift dramatically in the near future, the appropriateness of the technology can be rethought. Yemen's natural endowments do prime it to take advantage of drip irrigation practices, as its high rate of evaporation can be negated by the incremental technology. However, because water applications in this practice are largely unseen, it can be difficult to properly evaluate the operation of systems and the uniformity of water application. If the systems are mismanaged, crops can be under or over-irrigated and thus lacking in either quantity or quality. As a result, the government must accompany the implementation of drip irrigation systems with considerable oversight. Israel has demonstrated an inclination to help governments in developing countries introduce drip irrigation technologies, and the Yemeni government would be wise to seek such an arrangement.<sup>62</sup> This cooperation can make sequential water use another good option for Yemen, as Israeli tutelage can help Yemen to construct the technologies and regulations that provide safe and consistent water quality levels. NGOs can serve as an important complement to government agencies in the development of technologies and the introduction of new water management approaches.<sup>63</sup>

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<sup>60</sup> Ibid, 288.

<sup>61</sup> Megersa and Abdulahi, 33.

<sup>62</sup> Neena Rai, "Drip, Drip, Drip: Daniel Hillel Talks About How He Helped Revolutionize the Way Farmers Water Their Crops," *The Wall Street Journal*, October 15, 2012, accessed December 3, 2016, <http://www.wsj.com/articles/SB10000872396390443855804577602930583558076>.

<sup>63</sup> Ward, 152.

<sup>63</sup> Ward, 297.

To approach sustainability, these supply-side water management techniques must be accompanied by macroeconomic policies to manage its demand. Most notably, the country's incentive structure must be addressed to discourage groundwater exploitation through the implementation of a progressive increase in diesel prices alongside alternative activities to generate income for the poor. Water pricing must be allowed to adjust to market forces to reflect its value. Volumetric pricing would be a good choice for the government, a marked shift from current policy of no such resource charge. The negative consequences on the poor can be mitigated in the short-term through cash transfers, which should progress to a level of conditionality when both the populations and institutions can accommodate such an imposition.

## CONCLUSION

Yemen today is thus a product of its history: a country with a rich tradition of sustainable water use woefully forgotten in the hustle of rapid economic evolution. As a result, Yemen currently faces an acute crisis of groundwater depletion, compounded by conflict, climate change, and demographic shifts. This crisis can be partially attributed to difficult conditions, but much of it stems from faulty natural-resource policies that distorted prices, encouraged exploitation and discouraged cooperation. These policy failures were motivated by political conflicts and pragmatism and were allowed by the relative institutional vacuum that was the Yemeni state in the latter half of the twentieth century. However, these resource abuses have been recognized and thus, are ripe for reform. The government that arises out of the ashes of Yemen's bloody civil war will have a choice to make: it can either commit to implementing the changes needed to usher in a future of sustainable water use or it can ignore the policy failures that created the current state of crisis and allow the cycle of water scarcity and conflict to continue.

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