REMEMBERING RAIN

BY

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The story of drought is common and old. Civilizations have come and gone in its wake. This is a story of survival—a story of rain.

In many arid regions of the world, survival has long demanded an intricate relationship with and understanding of the rain. As the source of fresh water on Earth, rain is a crucial part of the natural cycle which sustains life. For millennia, across diverse cultures of the world, people employed rainwater harvesting methods as a means of providing for this most precious need.

As societies turn ever-increasingly to "modern," highly engineered water projects characterized by large, bureaucratic governments, we have forgotten the rain. It has receded from our daily concern. In turn, we have overexploited other freshwater sources, threatening our rivers and aquifers and the ecosystems they support.

Fortunately, the human memory is resilient, and we have not forgotten the ancient understanding of rain. In countries as diverse as the United States and India, traditional water harvesting methods that sustained cultures in their most arid landscapes have re-emerged to play a vital role in community water management.

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I. INTRODUCTION

A leaf stretches out and catches a drop of rain, channeling water toward the ground at its base; for millions of years, this simple rain collection technique has fueled life in many reaches of this planet. A few quiet moments in the rain are all we need to remind us of how plants catch and drink the rain. Yet, raised in a society where the government provides and regulates all the water we use, luxury has outpaced ancestral understanding. Perhaps in only the last few centuries, we have forgotten how to collect the rain, ignoring techniques developed over millennia by diverse civilizations to provide water to drink and irrigate crops. In the most arid regions of the planet, stretching across the modern Middle East, Africa, the Asian subcontinent, and the American southwest, our ancestors learned to turn as little as one-half foot of rain per year into enough water to drive flourishing cultures. Today, in the face of modern engineering of dams and wells and massive irrigation systems, water shortages in these regions fuel famine, disease, poverty, and conflict, though no less rain falls. Something is missing . . . and it is right over our heads.

Modern cultures predominantly draw on surface and ground waters to fill their water needs. As centralized control characterized by bureaucratic governments took control of water, the individual's responsibility for her own water declined. Traditional designs for providing moderate amounts of water have given way to large-scale public projects designed for total physical development and control of lakes, rivers, and aquifers. These methods have been insufficient to meet the needs of the poor in most parts of the world, and overextraction has put innumerable ecosystems at risk in those places where water development has fueled economic prosperity. All the while, rainfall sweeps across deforested lands, eroding topsoil and dumping silt into our rivers and streams. Runoff rages through concrete cities from rooftops and roads. Unable to seep into the ground to recharge aquifers and support rivers, it carries pollutants and toxins into the

waterways. Population growth in many countries has simply outpaced the current technology's capacity to provide water sustainably. Rivers are drying up. Water tables are falling. Regions that once supported forest ecosystems are barren, and people are abandoning them as inhospitable. Clean water is wasted by some as if it were a right to water a garden with Evian ("naïve" spelled backwards). This is not hyperbole—these are stories about forgetting rain. We should all take notice long before we have to depend on government water trucks to deliver a sip of water to our door. We must move ahead to the past.

Memory has proven resilient. Across the globe, rainwater harvesting techniques are reappearing in a variety of individual, community, and government projects. The solution to many of the world's water needs may well lie in the ability to manage and utilize rainfall and runoff. We can capture rainwater in barrels to water our houseplants. We can corral runoff or floodwaters with catchments to recharge groundwater for drinking or irrigation. We can revegetate deserts and bring back rivers, and we can do this while we reduce pollution and erosion and poverty and hunger. This effort is both as simple and as complex as the leaf of a plant. What it takes is a broad surface to collect the rain, guidance to a place to collect it, and the will to make it a part of our daily lives. We have the broad surfaces: a roof or the ground, for example. We can build the infrastructure: gutters and pipes, pumps and storage tanks, check dams and ponds. Most important, we need the will to make rainwater harvesting a part of our lives, by educating people to be responsible for their own water, fostering the political will necessary to remove legal barriers to rainwater harvesting, and developing cooperation between individuals, communities, and governments. Just as it is important for the Earth's hydrologic cycle, rainwater harvesting should be a part of the human strategy for water management.

The purpose of this Article is not to catalog every effort across the globe at reviving rainwater harvesting. We wish to demonstrate by a few examples that rainwater harvesting has had an important role in water management in our past and should have a similar role in our future.

Part II briefly outlines a very basic definition of rainwater harvesting through a description of the most common technologies for capturing the rain and putting it to use. Part III explores the ancient and modern uses of rainwater harvesting techniques in two very different places: India and the United States. This comparison demonstrates the broad utility and capacity of rainwater harvesting and the institutional barriers impeding water self-reliance. Finally, Part IV offers some suggestions for how rainwater harvesting can be encouraged as an effective means for meeting long-term water needs.

II. WHAT IS RAINWATER HARVESTING?

Rainwater harvesting requires two basic elements: a catchment—a broad surface to catch the rain—and a method or device for storing the

captured rain.[1] The catchment may be as simple as furrows in the ground or the roof of a building—the size, depth, and shape dictated by the region's topography, amount of rainfall, and the proposed use of the water.[2] The rainwater can then be stored in a variety of ways: in the soil to nourish plants, in cisterns or tanks for livestock and domestic purposes, or in ponds to water crops or to recharge groundwater.[3]

Traditional methods for capturing rain for crop irrigation, drinking water, and aquifer recharge developed over millennia across diverse cultures and regions of the globe.[4] These methods supported civilizations in arid regions that otherwise would not have allowed for agricultural production due to the lack of precipitation or the frequency of drought.[5] The names of and techniques for the capture and use of rainwater are as varied as the cultures and landscapes from which they developed. Further, elements such as rainfall amounts, volume of rainwater collected per area of catchment, runoff rates for rock, soils, or metals, and the volume or quality of water required to support plants, livestock, or humans are all design decisions particular to specific sites. However, a description of three basic methods, capable of employment in some form in almost any dry region of the world,[6] will serve as an adequate foundation for this discussion.

A. Microcatchments

A microcatchment is typically an area of ground dug out and supported by earthen walls (serving as "check-dams") to capture rainfall directly or to harness runoff from hillsides or floodwaters along the banks of rivers during periods of heavy rainfall.[7] This technique takes advantage of rainwater that evaporates too quickly to seep into the water table or to sustain plants as it moves over hot, dry land, or that would otherwise carry silt and surface pollutants away to streams and lakes. Microcatchments are usually

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[1] John L. Thames, *3.11 Water Harvesting*, *compiled in* UNITED NATIONS FOOD AND AGRIC. ORG. [FAO], THE ROLE OF FORESTRY IN COMBATING DESERTIFICATION, § 1, FAO Doc. T0115/E (1985), *available at* http://www.fao.org/docrep/T0115E/T0115E00.htm.

[2] *Id.* § 3.1.

[3] *Id.* § 3.3.

[4] *See id.* §§ 1–2, 5 (summarizing the history of rainwater harvesting worldwide and surveying case studies of rainwater harvesting installations worldwide); Adhityan Appan, President, Int'l Rainwater Catchment Systems Ass'n, Rainwater Harvesting: The Revival of Simple Methods, Keynote Address at the National Conference on the Potential of Rainwater Harvesting: Traditions, Technologies, Policies and Social Mobilisation (Oct. 1998), http://www.humanscape.org/Humanscape/new/jan01/hs010108.htm (last visited Jan. 28, 2007).

[5] John Palmbach, Traditional Water Harvesting, http://academic.evergreen.edu/g/grossmaz/palmbajp/ (last visited Jan. 28, 2007).

[6] *See* Thames, *supra* note 1, § 7 (explaining that water harvesting can develop water resources in arid regions and is most successful when tailored to local conditions, properly designed, and integrated into social practice).

[7] *See* Dieter Prinz, *Water Harvesting: Past and Future*, *in* SUSTAINABILITY OF IRRIGATED AGRICULTURE: NATO ADVANCED RESEARCH WORKSHOP PROCEEDINGS, VIMEIRO, PORTUGAL 4–7 (L.S. Pereira ed., 1996), *available at* http://www.ubka.uni-karlsruhe.de/vvv/1996/bau-verm/10/10.pdf.

employed in rural areas for watering livestock and crops and to aid in water retention to maintain water table depths.[8]

The simplest technique is to create microcatchments in low-lying areas or along moderate slopes. There are a variety of shapes employed depending on the landscape: diamonds in forested areas, contours or strips along slopes, and semi-circles along riverbanks.[9] These elements can be constructed and reinforced using very basic technology.

The amount of rainfall, the volume of water needed, and the area available for catchment purposes will determine the size of the catchment, which may range from small-scale "micro"-catchments to larger, more complex "macro"-catchments, hundreds of square meters in size.[10] Counter intuitively, the smaller the catchment structure, the more water it retains. For example, in dry regions, ten one-hectare catchments will yield more water than one ten-hectare catchment.[11] In the larger catchment, the water travels over more ground to reach the dam, thus is lost at a much higher rate to evaporation and to shallow seepage; the greater surface area of the larger catchment also increases losses to evaporation.[12] Therefore, smaller structures are more efficient and are well-suited for rural, community projects.[13]

These structures, as they often hold large volumes of water, must be well-maintained to ensure that the check-dams will not give way or be overcome by heavy rain or flood that could completely destroy the structure.[14] For this reason, larger catchments may require the knowledge and support of engineers for construction and maintenance. Also, catchments need to be inspected for weeds and insects that might cause structural damage.[15]

B. Rooftop Harvesting

Just as the ground may be used as an area to capture rainwater runoff, so too may rooftops, which provide a large and readily available catchment surface in both rural and urban settings. The basic rooftop harvesting system requires a roof of suitable material, as well as gutters or pipes to transport the collected water to a storage tank.[16] The roof must be made of a non-

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8 *Id.*

9 United Nations Food and Agric. Org., *Water Harvesting: A Manual for the Design and Construction of Water Harvesting Schemes for Plant Production*, §§ 1.3–1.4, FAO Doc. AGL/MISC/17/91 (1991), *available at* http://www.fao.org/docrep/U3160E/u3160e00.htm.

10 *See id.* § 1.3.2 (indicating catchment systems may be 200 meters in length); *see also* Prinz, *supra* note 7, at 2–7 (describing large catchment water harvesting).

11 ANIL AGARWAL, CTR. FOR SCI. & ENV'T, DROUGHT? TRY CAPTURING THE RAIN 9 (2000), *available at* http://www.rainwaterharvesting.org/downloads/drought_english.pdf.

12 *Id.*

13 *Id.* at 10.

14 Prinz, *supra* note 7, at 2–3; Thames, *supra* note 1, § 4.7.

15 Thames, *supra* note 1, § 4.3.

16 Int'l Rainwater Catchment Sys. Assoc., Factsheet: Domestic Roofwater Harvesting for Low Income Countries, http://www.ircsa.org/factsheets/lowincome.htm (last visited Jan. 28,

porous material, such as non-corrosive metals, plastic, or tile, to facilitate runoff and avoid adversely affecting water quality.[17] In turn, the gutters, pipes, fittings, filters, taps, and storage system must also be made of materials that will not corrode or contaminate the water.[18] Storage containers are often made of concrete, fiberglass, or stainless steel in modern systems,[19] but have traditionally been made of wood or clay, which may still be employed according to cost and quality needs.

Water volume and quality needs will also determine the complexity and overall cost of rooftop harvesting. "Rain barrels" for watering gardens and landscapes are an example of the most simple rooftop systems, which require little in terms of investment of money, time, training, or expertise.[20] Rainwater used for watering plants or washing clothes, for example, may only require moderate filtration to screen out debris and minor contaminants. Some systems employ a first flush mechanism which flushes away the first few gallons of water collected, since this water is more likely to contain debris and contaminants from the rooftop.[21] Harvesting rainwater for drinking, a more sensitive use, may require a correspondingly more complex approach. However, the quality of rainwater is, with the exception of areas of heavy air pollution, superior to well or tap water, usually softer and with fewer dissolved solids.[22] Most untreated rainwater meets World Health Organization (WHO) minimums for water quality and in many areas far exceeds the quality of the groundwater.[23] Systems that are well-built and maintained may safely utilize rainwater for drinking purposes if airborne pollutants do not contaminate rain or rooftops. In countries with strict water quality standards, laws may require more filtration or treatment, which might be accomplished in a variety of ways, such as with bleach, chlorine, UV filtration, and ozonation.[24] Additionally, well-sealed fittings and pipes and opaque tanks will usually prevent any bacteria growth in stored water.[25]

2007) [hereinafter Factsheet].

17 *Id.*; *see* UNIT OF SUSTAINABLE DEV. & ENV'T, ORG. OF AM. STATES, SOURCE BOOK OF ALTERNATIVE TECHNOLOGIES FOR FRESHWATER AUGMENTATION IN LATIN AMERICA AND THE CARIBBEAN § 1.1 (1997), *available at* http://www.oas.org/dsd/publications/Unit/oea59e/ch10.htm#1.1%20rainwater%20harvesting%20from%20rooftop%20catchments [hereinafter FRESHWATER AUGMENTATION].

18 FRESHWATER AUGMENTATION, *supra* note 17, § 1.1.

19 *Id.*

20 *Id.*

21 *Id.*

22 Stephen K. Beers, *Sourcing Water from the Sky*, ENVTL. DESIGN & CONSTR. MAGAZINE ONLINE, Jan. 25, 2001, *available at* www.edcmag.com; *see* Doug Pushard, Is Rainwater Really Safe—One Sample Case, http://www.harvesth2o.com/rainwater_safe.shtml (last visited Jan. 28, 2007) (noting well water will generally have higher mineral and metal content depending on soil conditions, while rainwater will not have these issues but may be effected by local air pollution and debris in the catchment).

23 Factsheet, *supra* note 16.

24 Beers, *supra* note 22.

25 *Id.*

C. Artificial Recharge

Where water is not immediately needed for irrigation or drinking purposes, the artificial recharge form of rainwater harvesting can be used to maintain water table depth. Artificial recharge utilizes pits designed to percolate water down into aquifers below. The most basic form consists of deep pits dug in low-lying areas where runoff water flows. These basins are filled with loose materials such as bricks, pebbles, or sand, which filter the water as it works down into the groundwater.[26] This method of rainwater harvesting is applicable in both rural and urban settings. It is particularly useful where runoff either does not readily seep into the ground because large, non-porous surfaces like concrete or poor draining soils like clay prevent seepage, or where there is insufficient vegetation to trap runoff.

As with the other methods, this technique can be either simple and low-tech or more technical and complex depending on the nature of the soil, the volume of water that the pit is designed to handle, and the end use planned for the water. Where soils are loose and may shift, concrete reinforcement of pits will help maintain the structure.[27] Where impermeable soils reach depths not easily dug by hand, construction may require large augers or other drilling technology, and shafts may need reinforcement by PVC pipe.[28]

The above mentioned methods for harvesting rainfall and runoff can be employed in concert to create a more efficient system. For example, rooftop catchments may be combined with absorption pits as a way of reusing overflow from storage or from first flush systems, draining it down to recharge groundwater.

Simple to complex, cheap to expensive, rural to urban, these methods have evolved over thousands of years to augment human water supplies in regions across the globe. Though many such methods have been forgotten, elbowed out by highly-engineered water "improvements," these simple techniques have demonstrated great potential.

III. THE ILLUSION OF SCARCITY AND THE MYTH OF ABUNDANCE

The Earth's production of freshwater—just 2.5% of all water on the planet[29]—is a balanced, but very slow process.[30] Rain falls; the ground

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[26] *See* Tamilnadu Water Supply and Drainage Bd., Rainwater Harvesting: Methods, http://www.aboutrainwaterharvesting.com/rwh_methods_pitmethod.htm (last visited Jan. 28, 2007) [hereinafter Tamilnadu]; Nayantara Nanda Kumar & Niranjan Aiyagari, Artificial Recharge of Groundwater (Fall 1997), http://www.ce.vt.edu/program_areas/environmental/teach/gwprimer/recharge/recharge.html (last visited Jan. 28, 2007).

[27] Tamilnadu Water Supply and Drainage Bd., Rainwater Harvesting: Well Cum Bore Method, http://www.aboutrainwaterharvesting.com/rwh_methods_boremethod.htm (last visited Jan. 28, 2007).

[28] *Id.*

[29] Barda Ghista, World Prout Assembly, Weeping for Water (Apr. 10, 2006), http://www.worldproutassembly.org/archives/2006/04/weeping_for_wat.html (last visited Jan. 28, 2007).

[30] Lawrence Gamble, *Collecting Rainwater: Supply All Your Water Needs with Rain*, THE

catches the water, storing some of it for life on the surface; the remainder percolates downward, filtering impurities, providing base flow to surface waters, and filling aquifers. It is not a linear process—rain falls, we drink. It is a true cycle in which the sun continually changes saltwater from the world's oceans into purified freshwater, and the neglect of any part of the cycle disrupts the process. Water is a circle; we cannot treat it as a line that ends with human consumption.

Painfully slow has been our integration of our scientific understanding of hydrology and watersheds with the actual management and use of water. Forest policies have allowed vast devegetation of the land, robbing the ground of its capacity to retain water, resulting in greater runoff, evaporation, and pollution. Agricultural policies have encouraged waste of water and, when the rivers are over-appropriated, farmers exhaust aquifers millions of years in the making. Examples of misguided legal, economic, and social policies affecting water are legion.[31]

The natural cycle is fine; we are out of sync. In some areas, the perception is of too little water.[32] In others, the perception is that water is perpetually abundant—that we may let the tap run. Growing recognition that neither view is sound has led to a surge in rainwater harvesting projects around the globe—deserts bloom and waste gives way to balance.[33] This

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IOWA SOURCE, Apr. 2006, http://www.iowasource.com/home_garden/rainwater_0604.html (last visited Jan. 28, 2007).

> Rainwater is naturally purified and distilled by the sun. The Earth's systems that purify and distribute water as rain are a marvel of nature's engineering, operating for billions of years without human intervention. We are interconnected to all the waters of the Earth by these systems—the cup of tea you drink almost certainly has molecules that were once in Cleopatra's bathwater.

Id.

[31] *See generally* David Getches, *Water Wrongs: Why Can't We Get It Right?*, 34 ENVTL. L. 1 (2004) (discussing failures throughout the ages to conform our actions with our understanding of water); ROBERT GLENNON, WATER FOLLIES: GROUNDWATER PUMPING AND THE FATE OF AMERICA'S FRESHWATER (2002) (describing the almost perverse misuse of water in the United States).

[32] This assumption is belied by the example of the Negev Desert in modern day Israel. People of that region employed rainwater harvesting techniques over 4,000 years ago. U.N. Food and Agric. Org., *supra* note 9, § 1.1.1. These techniques made 300,000 hectares of productive agricultural land in a desert receiving only three to four inches of rain a year. Matthew W. Fidelibus & David A. Bainbridge, Microcatchment Water Harvesting for Desertrevegetation (July 1994), http://www.serg.sdsu.edu/SERG/techniques/microcatch.html (last visited Jan. 28, 2007).

[33] For more on projects around the world, including efforts in Brazil, China, Germany, Japan, Singapore, and Thailand, see U.N. ENV'T PROGRAMME, RAINWATER HARVESTING AND UTILISATION: EXAMPLES OF RAINWATER HARVESTING AND UTILISATION AROUND THE WORLD ch. 9 (2000), *available at* http://www.unep.or.jp/ietc/Publications/Urban/UrbanEnv-2/9.asp. *See also* John Gould, *Contributions Relating to Rainwater Harvesting* 17–24 (World Comm'n on Dams, working paper No. IV.3, Oct. 24, 1999), http://www.wca-infonet.org/servlet/BinaryDownloaderServlet?filename=1067009195199_harvesting.pdf&refID=116636 (last visited Jan. 28, 2007).

> We have much to re-learn from traditional water management experience. Small-scale indigenous systems can often be more effective at meeting community needs without the large, unexpected impacts of large-scale developments, and community-level

Article focuses on examples from these perceived extremes—India and the United States. Though not an exhaustive review, these stories demonstrate that rainwater harvesting is important and relevant everywhere.

A. India: The Illusion of Scarcity—Toward Jal Swaraj[34]

Perhaps nowhere on the planet are the ironies of modern water management policies more apparent than in India. India, one of the world's wettest countries, receives nearly 400 million hectare-meters (mham) of rainfall annually and demand is predicted to reach 105 mham by 2025, yet it faces a deepening crisis over water supply for its population of nearly one billion.[35] India's massive investment in water infrastructure—focused almost exclusively on tube wells to extract groundwater and dams to draw on rivers—left these water sources overexploited and unable to meet demand.[36] Disruption of the hydrologic process has deprived the system of its ability to replenish water supplies naturally. The water table is declining and rivers are running dry,[37] exacerbating problems with hunger, poverty, pollution, and disease. By 2025 the United Nations predicts India's water table will reach "catastrophically low" levels.[38]

It has not always been this way for India. For millennia the Asian subcontinent has been home to civilizations thriving on an understanding of the rain.[39] Even in the nation's driest deserts, which receive as little as 100 mm of water per year and lack perennial water sources, there is no village in

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> participation in water supply development and management often leads to other economical, educational, or health benefits as well . . . .
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> . . . Unfortunately, such traditional approaches are often ignored by the international development community and governments. They are excluded from surveys of water systems, they do not get investment credits from international development programs, they are denied the support of information and education services, and they lack the glamour and high profile of projects.

Id. at 5 (internal citations omitted).

34 M.S. SWAMINATHAN ET AL., CTR. FOR SCI. AND ENV'T, JAL SWARAJ: A REPORT ON THE TECHNICAL, LEGAL AND ADMINISTRATIVE ISSUES CONCERNING THE *JOHAD* IN LAVA KA BAAS 1 (July 2001) (on file with authors).

35 Anil Agarwal & Sunita Narain, *Making Water Management Everybody's Business: Water Harvesting and Rural Developments in India*, 87 Gatekeeper Series (Int'l Inst. for Env't Dev., London, Eng.), 1999, at 3–4.

36 Anil Agarwal, *Water Harvesting in a New Age: When the State has Reached its Limits, Community Participation Becomes Essential*, *in* MAKING WATER EVERYBODY'S BUSINESS: PRACTICE & POLICY OF WATER HARVESTING 3 (Anil Agarwal, Sunita Narain & Indira Khurana eds., 2001).

37 Agarwal & Narain, *supra* note 35, at 3.

38 P. Srivatsan, *India Thirsts for Better Water Management Practices*, HINDU BUS. LINE, July 6, 2005, http://www.thehindubusinessline.com/2005/07/06/stories/2005070600220900.htm (last visited Jan. 28, 2007).

39 Agarwal & Narain, *supra* note 35, at 5.

India which could not meet all of its water needs from the sky.[40] Thirst, disease, desertification, and poverty prove that something has gone desperately wrong.

1. The Past: Fertile Deserts

India's water harvesting tradition is one of the lengthiest and most successful anywhere in the world. Examples abound across the entire subcontinent, adapting to varying climates and topography but dealing with one commonality—the monsoon. Across most of India, the majority of the rain falls in just about four days out of the entire year; Indians for many centuries understood that if they did not capture these rains, there might not be enough water for the rest of the year.[41] They developed a number of traditional methods, including rooftop catchments to collect and store rainwater in tanks called *tankas*, earthen microcatchments that direct water into wells called *kundis*, and catchments and check-dams along rivers called *ahars*, *zings*, and *johads* capturing monsoon flood waters.[42]

Evidence of this tradition is found in ancient Hindu and Buddhist texts and in archaeological remains dating back several thousand years.[43] In the driest deserts, the smallest villages, and the largest cities, rainwater harvesting methods were adapted to each particular site.[44] For the Indus Valley civilization, rainwater harvesting was a way of life in an area which had no perennial rivers or lakes, where groundwater was brackish and saline, and annual rainfall was only about 260 mm. In the third millennium before the Common Era (BCE), this amount of rainfall supported the largest cities in India's history, which harvested monsoon runoff along nearby rivers and rainfall with catchment systems in the citadel.[45] In the modern state of Rajasthan, the palace of Alwar, built in the seventeenth century CE, still displays a water park graced with a water maze that transforms rainfall into artwork, demonstrating the culture's deep understanding of and extensive experience with rainwater harvesting.[46]

These examples illustrate that rainwater harvesting was an adaptive technique that sustained Indian civilization across many centuries. So ingrained was this life-sustaining practice that "build[ing] a *johad* . . . was considered a sure route toward enlightenment."[47] Yet over the last century and a half, many Indians have forgotten this way of life. This phenomenon is largely the result of two major changes in water management in India: the greater centralization of the management of water (and other) resources and

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40 AGARWAL, *supra* note 11, at 4–6.

41 *Id.* at 4.

42 *Id.* at 4–5.

43 Agarwal & Narain, *supra* note 35, at 5.

44 Suzanne Charlé, The Greening of Sariska Park (Summer 2001), http://www.ford found.org/publications/ff_report/view_ff_report_detail.cfm?report_index=297 (last visited Jan. 28, 2007).

45 Agarwal & Narain, *supra* note 35, at 5.

46 Charlé, *supra* note 44.

47 Agarwal & Narain, *supra* note 35, at 5.

the replacement of simple technologies with large-scale dam and well projects.[48]

Greater government centralization by the British spelled doom for many individual and village efforts to harvest the rain. In the effort to maximize profits, the government (both British and Indian) centralized control of resources, which marginalized and impoverished rural communities, leaving communal water harvesting projects to dry up and die.[49] The forests of the Alwar district in Rajasthan provide a vivid example of centralization's impacts.[50] The government took control of forest lands and sold them off for revenue.[51] As the country was deforested, rural communities lost a needed resource that they once managed communally.[52] Worse still, previously forested watersheds deteriorated.[53] The soil lost the capacity to retain water, leaving many areas unfit for agriculture. Runoff carried the loose soil across dry, barren land, silting the rivers.[54] The place just dried up. And, as the central government came to be the sole provider of water and villagers had less and less to contribute to community water needs, rainwater harvesting literally evaporated.[55] Further eroding tradition from the minds of Indians, education in poor areas slipped, while in rich areas it grew more heavily influenced by European teaching.[56]

The central government shifted to modern technology for providing water—to the near exclusion of rainwater harvesting—abandoning centuries-old, sustainable infrastructure.[57] The British even mistook the microcatchments along the rivers for breached flood walls built by incompetent natives, so they bulldozed them, filling the *johads* and keeping the vital monsoon waters from replenishing the soil.[58]

The result: the government continues to build more dams and dig wells deeper as rivers dried up and the water table fell.[59] Water is in short supply. Unpolluted water is becoming scarce. This problem only gets worse as cities swell, as the only place people have a chance at survival. In India, recent droughts are not entirely "natural" disasters. They are in part government-made.[60]

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48 SWAMINATHAN, *supra* note 34, at 3.

49 Agarwal & Narain, *supra* note 35, at 7.

50 Ctr. for Sci. & Env't, *Waters of Life*, DOWN TO EARTH, Mar. 15, 1999, at 1–4, *available at* http://www.downtoearth.org.in/cover.asp?foldername=19990315&filename=Anal&sec_id=7&sid=1 [hereinafter *Waters of Life*].

51 *Id.* at 1.

52 *Id.* at 1–2.

53 *Id.* at 3.

54 *Id.*

55 Agarwal & Narain, *supra* note 35, at 7–8.

56 *Id.* at 9.

57 Gould, *supra* note 33, at 4.

58 Agarwal & Narain, *supra* note 35, at 8.

59 Ctr. for Sci. & Env't, Drought—A Government Made Natural Disaster, http://web.archive.org/web/20021115081005/http://www.cseindia.org/html/cmp/cmp43_drought.htm (last visited Nov. 10, 2006).

60 AGARWAL, *supra* note 11, at 1–2.

2. Wisdom Survives: From Dark to White

There are many stories of selfless and humble people across India who, in the face of this crisis, sought to ease suffering in rural villages. We cannot tell all of them here. However, there is a story from the Alwar district in Rajasthan that demonstrates ancient wisdom and the power of the people in India, and people should hear it.

By 1985, villages in this district had faced five straight years of drought. Elders told tales of a greedy prince who sold off all the timber which once covered the mountains nearby, and soon the tigers disappeared, the soil eroded, and the land became infertile.[61] The government declared the region a "dark zone, a place with so little water it soon might no longer be able to sustain man or beast," and ordered seventeen villages to evacuate.[62] This is the story of their resistance.

An NGO formed in the late 1970s called Tarun Bharat Sangh (TBS—translated, Young India Association) staged marches through drought-stricken villages trying to raise awareness about water sufficiency.[63] An elder in one of the villages told the group of young intellectuals, "you educated people talk a lot . . . if you really want to do something, bring the axe and spade and come to me."[64] Five members of TBS did just that in 1985. They bought bus tickets for the last stop on the route, kissed their loved ones goodbye, and headed for the village with nothing but bedding.[65] Once settled, they sought the wisdom of the people to determine how they might help. And, in the village of Gopalpura, they found the answer: a village elder who could remember when the village had been green and productive told them, "[if] you're interested in helping the village, build a *johad*."[66] So, they gathered villagers—mostly women, because the able-bodied men had left the village in search of work to support their families[67]—and together they de-

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61 Vijaya Pushkarna, *Kiss of Life for Mother Earth*, THE WEEK, Dec. 27, 1998, http://web.archive.org/web/20030628002716/http://www.the-week.com/98dec27/cover.htm (last visited Nov. 15, 2006).

62 Charlé, *supra* note 44 (quotations omitted).

63 Bansuri Taneja & Swati Shresth, Green at the Grassroots: Reviving the Past to Secure the Future (2005), http://web.archive.org/web/20010530183754/http://www.humanscapeindia.org/hs0200/hs2005t.htm (last visited Nov. 15, 2006).

64 Abha Sharma, *Community in Conservation*, DECCAN HERALD, Aug. 5, 2001, http://web.archive.org/web/20020114075558/http://www.deccanherald.com/deccanherald/aug05/sl10.htm (last visited Nov. 15, 2006).

65 Pushkarna, *supra* note 61.

66 Charlé, *supra* note 44.

67 *See generally id.* (explaining that "men had been forced to leave their villages in search of work").

> The story of the rebirth of the 90-km-long Ruparel river, which had dried up, began with two women of Mala Tolawas, a village high up on a ridge in the Sariska Hills. This is where the first tributary of the river starts trickling down. The women, Gyarsi and Phoola, were the only human beings left in the village, the others having died or fled. A TBS volunteer who climbed up the ridge some time in 1987 suggested that they dig a pond: the two women did it in four months, with help from the volunteer who visited them every ten days.

silted and deepened a check dam along the Arvari River, which had almost completely stopped flowing. After the monsoon, the pond filled to a level most had never seen, and the water quickly seeped into the water table recharging the aquifer, re-filling wells.[68] Soon, TBS began helping villages all along the Arvari to do the same.

In the last 20 years, TBS and the people of Alwar district have completely remade the riverbed's ecosystem, its economy, and the lives of its people.[69] To date, they have constructed over 7,500 earthen structures to capture rainwater and monsoon runoff.[70] Villages, once abandoned, have come back to life as many men have returned to work their own fields. The wells are full of water and have sustained the villages through continued drought.[71] The villagers' reforestation efforts have helped the woodlands grow, prompting tigers and panthers to return along with badger, fox, antelope, and deer.[72] Most remarkable, through the collective efforts of the villages in the basin, rivers that *no one* could remember flowing, even after the monsoon, have returned. Now the Arvari and four other rivers in the basin flow perennially.[73] These successes have been so widespread that the government has reclassified the area as a place of sufficient potable water: a "white zone."[74]

These efforts have helped the villagers economically and socially as well. They can now grow crops and support their families without having to leave the village; many villages have doubled agricultural land under production and can raise livestock.[75] Water sufficiency has also reduced the cost and time associated with providing water. In many villages, for every 100 Rupees invested in rainwater harvesting, the economic production of each villager has risen by 400 Rupees.[76] Now women, who have traditionally been primarily responsible for retrieving water for their families, have much more time to help in other areas: educating children, raising crops, and

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> That year the pond had water only for three months, but within two years it was rippling all year along. By then villagers downstream had also adopted water harvesting techniques. Eventually 350 ponds and check-dams were built on the Ruparel basin, turning the river perennial.

Pushkarna, *supra* note 61.

68 *See* Charlé, *supra* note 44.

69 *See* Sharma, *supra* note 64, at 3.

70 NATALIE ARSENAULT, PEOPLE AND PLACE: CURRICULUM RESOURCES ON HUMAN-ENVIRONMENTAL INTERACTIONS 160–61 (2005), *available at* http://www.utexas.edu/cola/orgs/hemispheres/content/resources/PDF/geo/india_*johad*.pdf.

71 Charlé, *supra* note 44.

72 *Id.*; *see also* Taneja & Shresth, *supra* note 63 (describing successful reforestation, conservation, and resource management efforts between several villages, including the creation of large wildlife sanctuaries).

73 *Id.*; *see* Ctr. for Sci. & Env't, *The Arvari: Coming Back to Life*, DOWN TO EARTH, Feb. 28, 1999, at 37, *available at* http://www.downtoearth.org.in/full6.asp?foldername=19990315&filename=Anal&sec_id=7&sid=4#j [hereinafter *The Avari*].

74 Charlé, *supra* note 44.

75 ARSENAULT, *supra* note 70, 160–61.

76 *Waters of Life*, *supra* note 50.

making decisions in village affairs.[77] Nearly seventy informal schools have been formed in an area that is over 90% illiterate, and girls are attending class for the first time. [78] And health in the villages has improved dramatically with clean water and more food to eat.[79]

The list of successes and benefits goes on. Community-based rainwater harvesting, such as that employed in the Arvari River basin, has the potential to drought-proof all of India, to relieve stress on surface and groundwater sources, and to provide the people with their most precious need.[80] The greening of Alwar district is not a rare miracle, nor is it a fairy tale. It is the story of people understanding and valuing the rain, and it is possible anywhere, unless those in power succeed in destroying it. In Rajasthan, they tried.

3. The Struggle: Community Versus Government

The story of a *johad* in the town of Lava Ka Baas in Rajasthan is illustrative. Villagers there, with the help of TBS, completed a large *johad* in 2001 which helped to irrigate areas previously unsuitable for agriculture due to drought.[81] This was one of more than 550 *johads* that had been constructed in the watershed of the Ruparel River.[82] Unexpectedly, the government stepped in. In June of 2001, it ordered TBS to halt construction and tear the *johad* down or face arrest.[83] The government cited two sources to contend that the check dam was illegal: the Rajasthan Irrigation and Drainage Act of 1954 and a 1910 river distribution agreement between the provinces of Alwar and Bharatpur.[84] Under the Irrigation and Drainage Act, the government argued that the *johad* unlawfully "endanger[ed], damage[d] or render[ed] less useful an[] irrigation or drainage work."[85] Yet, the government made no finding as to what damage the *johad* had done to any other irrigation structure and ignored an explicit exception in the law for minor irrigation works like *johads*.[86] Similarly, under the Alwar-Bharatpur agreement, the government did not present an argument for why the *johad* upset the agreement and could not even produce a legible copy of the agreement to support its claim.[87] It would have been difficult to support the contention that the *johads* had done any harm—the structures had revived

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77 Gould, *supra* note 33, at 8.

78 Charlé, *supra* note 44.

79 Pushkarna, *supra* note 61.

80 AGARWAL, *supra* note 11, at 4–5.

81 Sunny Sebastian, *Villagers' Efforts Washed Away*, THE HINDU, July 16, 2003, *available at* http://www.hinduonnet.com/2003/07/16/stories/2003071605291200.htm.

82 Ctr. for Sci. & Env't, Alwar Dam Update, http://www.cseindia.org/html/extra/dam/index_story.htm (last visited Jan. 28, 2007) [hereinafter Alwar Dam Update] (providing a timeline for the *johad* in Lava ka Baas, from construction to its ultimate destruction).

83 *Id.* The law provided for arrests without a warrant in situations where persons violated the Irrigation and Drainage Act of 1954. *Id.*

84 SWAMINATHAN, *supra* note 34, at 6.

85 *Id.* (quoting § 58(2) of The Rajasthan Irrigation and Drainage Act of 1954).

86 *Id.*

87 *Id.* at 7.

the Ruparel River, which now flowed year round, to the benefit of all in the watershed.[88]

The government failed to tear down the *johad* in Lava Ka Baas with these hasty and strained legal arguments. When it showed up to destroy the *johad*, the villagers stood their ground, declaring "they can kill us, but they cannot demolish the *johad*."[89] They maintained a constant vigil at the site for weeks, drawing support from hundreds of people in neighboring villages.[90] Aided by TBS and India's Center for Science and Development, the village saved the *johad*, but the dam had to be partially torn down to reduce its size. However, the government's continual interference in village efforts to preserve the *johad* ended in disaster. The local government had fervently blocked village efforts to maintain and reinforce the check dam, until breaches at seven dams above the Lava Ka Baas structure finally proved too much, and the dam collapsed due to neglect.[91] After the *johad* at Lava Ka Baas had sustained the villagers through serious drought in 2002 and 2003, the government succeeded in destroying it.[92] Ironically, the controversy centered around a pond in a hilly section of Rajasthan, *23 kilometers* from the Ruparel River in an area where the government provides no water.[93] Sadly, this dispute drove the government to the extreme declaration that it owns every drop of water.[94]

The struggle over village water sufficiency, though complicated by government interference for decades,[95] has revived and empowered many communities.[96] The people have begun to re-learn to take responsibility for their own water in response to government water-policy failures. In the face of government resistance, many villages have united to defend their efforts. They have formed coalitions to save forest lands and maintain biodiversity, to manage erosion, and they cooperate to employ sustainable water practices and keep the *johads* and other structures maintained.[97] To ensure

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[88] *Id.* at 8.

[89] Ctr. for Sci. & Env't, *People Fight Back*, CATCH WATER, Aug. 2001, http://www.rainwaterharvesting.org/catchwater/aug2001/campaign.htm (last visited Jan. 28, 2007).

[90] Alwar Dam Update, *supra* note 82.

[91] *Id.* The villagers even tried to do repairs at night, but were consistently thwarted by officials from Alwar and Bharatpur. *Id.*

[92] Sebastian, *supra* note 81.

[93] SWAMINATHAN, *supra* note 34, at 4.

[94] *See* Alwar Dam Update, *supra* note 82, (noting a report in the Hindustan Times containing a declaration by Rajathan irrigation minister Kamla Beniwal that "every drop of water that is received through the rains comes under the irrigation department").

[95] The examples are numerous and varied across India. One example is that on the Arvari river, after the villagers brought it back to life, the government contracted fishing rights to entities outside the province and challenged the locals right to fish. *See* Sunny Sebastian, *The River is Our River*, 9 HUMANSCAPE 3, Mar. 2002, *available at* http://www.humanscape.org/Humanscape/new/mar02/theriver.htm. The villagers organized and forced the government to relent on the fishing licenses, preserving the river for their communities. *Id.*

[96] *The Avari*, *supra* note 73.

[97] *Cf.* Sebastian, *supra* note 81 (discussing the various initiatives undertaken by local villages working together to preserve environmentally sensitive areas, promote sustainable agriculture, conserve water, and administer the maintenance and construction of *johad*s on the Arvari River).

their voice in issues surrounding their rebuilt watershed, over 150 members from seventy villages joined to form the Arvari River Parliament in 1999.[98] Though the government has resisted these efforts as well, the moral force of this and similar groups has sustained their existence and effectiveness.[99] The people of Rajasthan played a vital role in rejuvenating a dying watershed over 500 square kilometers in size and have formed grassroots democratic structures to cooperate in watershed maintenance—they have reached their *jal swaraj*. And it all began with an elder's memory of the rain.

B. United States: The Myth of Abundance—After We Have Dammed All the Rivers

Here, the centralization of water is complete.[100] The settlement of the Great Plains and the West is a tale of relentless federal efforts to settle, develop, and irrigate what was known as the Great American Desert.[101] So successful was this program that even in the most arid regions, people do think about the water that streams unending from the tap. With only the rare and occasional exception in the United States, we can turn it on and let it run—fill up a pool or grow cotton in the desert. Many think it will always be available, but will it? Dams on rivers large and small throughout the West strain the capacity of surface waters; irrigation projects draw on aquifers while water tables decline.[102] The problems faced by many Indians in Rajasthan may not be as far off as they seem, particularly given this region's history of long periods of drought. Just as in India, the modern mechanisms for controlling water may be quite adept at channeling water out of the rivers and ground, but may be inadequate to augment the freshwater cycle in a way that will sustain water's availability, particularly when faced with environmental disturbances such as severe drought.

Just as in India, the civilizations that preceded ours in the American southwest used their knowledge of their climate and environment to support productive cultures. Their wisdom offers valuable insights into how we might bring this region into balance.

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98 *Id.*

99 The Right to Water, Community Water Management—The Story of the 'Avari River Parliament': India, http://www.righttowater.org.uk/code/community_1.asp (last visited Jan. 28, 2007) (describing the Avari River Parliament as one among many successful examples of revivals of traditional water management practices).

100 The story of Western water's centralization and development is an oft-told tale. *See, e.g.*, MARC REISNER & SARAH BATES, OVERTAPPED OASIS: REFORM OR REVOLUTION FOR WESTERN WATER 3–26 (1990).

101 *Id.*

102 *See id.* at 26–47; *see also* Getches, *supra* note 31, at 1–6 (describing how irrigation turned Mesopotamia into a desert, and discussing the environmental harms created by dam projects in the American West). *See generally* LAWRENCE J. MACDONNELL, FROM RECLAMATION TO SUSTAINABILITY (U. Press of Colo. 1999) (demonstrating the shortfalls and limitations of federal water policies in the West by focusing on five river basins in Colorado, Washington, and Nevada).

1. The Past: America's Ancient Southwest

For thousands of years in the American southwest and in Central America, indigenous cultures supported large populations with agricultural practices augmented by their ability to capture, store, and manipulate rainwater and runoff.[103] To cope with the very dry climate, the cultures inhabiting these areas developed a variety of techniques for capturing the rain. The Zuni used terracing along hillsides which slowed the rate of runoff during the summer monsoons.[104] This method drastically reduced the erosion of hillsides and allowed soils more time to absorb the rain.[105] The Zuni also used "waffle gardens," digging grid-like growing areas with short dirt walls to capture and retain rainfall.[106] Cultures in Mexico developed a method of irrigation utilizing buried clay pots with openings at the surface.[107] This method allowed water to slowly seep through the clay pots, keeping soils consistently moist at twice the efficiency of modern drip irrigation systems.[108] The Anasazi, known for their pueblo dwellings on a river-less mesa in southwestern Colorado, used a series of dams and canals to channel rainwater into large cisterns that stored water to support their communities.[109]

Some might not consider these efforts remarkable—merely inventions mothered by necessity in a subsistence culture struggling to survive in an arid landscape. But these cultures demonstrated an understanding of the rain and of their environments that reaches far beyond physical manipulation of water. Many cultures augmented their water collection techniques with an intricate understanding of crop interactions. For instance, some would use cluster plantings such as the "three sisters": corn, beans, and squash. The corn stalks provided support for the beans to twine up; the beans replenished the soils; and the leaves from squash acted as living mulch, helping the soil retain moisture.[110] New research is uncovering an even more sophisticated understanding of the rain by the Hohokam and Anasazi. Stone-walled depressions appear by the thousands in the southwest. Early researchers thought these areas were ball courts for sporting events or areas for community dances or religious ceremonies.[111]

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103 *See* John Palmbach, Traditional Water Harvesting, http://academic.evergreen.edu/g/grossmaz/palmbajp/ (last visited Jan 28, 2007); Jay B. Norton & Jonathan A. Sandor, *Combating Desertification with Indigenous Agricultural Technology at Zuni Pueblo, New Mexico*, ARIDLANDS NEWSLETTER (U. of Ariz., Tuscon, Ariz.), Spring/Summer 1997, http://cals.arizona.edu/OALS/ALN/aln41/norton.html (follow "historical setting" hyperlink) (last visited Jan. 28, 2007).

104 *See* Norton & Sandor, *supra* note 103 (discussing Zuni usage of runoff farming).

105 *See id.* (discussing increased soil quality due to increased water absorption).

106 Jodi Torpey, *Irrigation Wisdom from the Ancients: Indians' Water-frugal Ways Useful Today*, THE DENVER POST, May 27, 2005, at L8.

107 *Id.*

108 *Id.*

109 *Id.*

110 *Id.*

111 Richard D. Fisher, Ancient Knowledge of the Chaco Canyon Anasazi, http://www.canyonsworldwide.com/chaco/images/ChacoCanyonAnasaziPaper.pdf (last visited Jan. 28, 2007). This is

Researchers are now positing that these were a system of swales and catchments designed to catch rainwater from thunderstorms.[112] This rainwater—when ionized with lightning—contains a higher concentration of nitrogen, which is a necessary component for growing crops.[113] In addition, rainwater washing over the dry soils was directed to catchments likely because of the high nitrogen content of the blue-green algae growing in the soil.[114] By combining these nitrogen-rich waters with organic materials, such as graywater, these cultures created a liquid fertilizer that they used to grow corn.[115]

Admittedly, these techniques supported societies much smaller than the one that now inhabits the American southwest, but this incredible wisdom has value as we look to manage water in ways that are more sustainable than the ones we have chosen.

2. Wisdom Survives: Scattered Memory and Fractured Response

As is the case in India, success stories in the United States are emerging out of remembering and revisiting these age-old, but effective techniques for augmenting water supplies. Again, we will not try to catalog each of those efforts, but will demonstrate the breadth of possible applications of rainwater harvesting and some of the basic responses by state governments to these efforts.

In Colorado, on the very lands where many of these techniques were developed and perfected over the centuries before Europeans arrived, the state government shares a policy with the local authorities in Rajasthan—Colorado's Division of State Water Resources has declared that all precipitation is part of the tributary to a natural stream, thus, it is property of the state.[116] Rain barrels are technically illegal. Perhaps a homeowner could position her gutters to spill directly onto the area she wishes to irrigate, but even that approach is technically illegal, because it is a "diversion" of water; yes, in Colorado, gutters might even be illegal.[117] This is so even despite the

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strikingly similar to the British misunderstanding of Indian flood plain catchments. *See* text at *supra* note 58. We assume first that the cultures did not have such an advanced understanding.

112 *See* Fisher, *supra* note 110; Richard D. Fisher & Kate Bauer, The Unifying Theory of Seven Elemental Hypothesis for Archaeological Interpretations of Oasis America, Fertilizer and Crop Production (June 2004), http://www.canyonsworldwide.com/fisher/site.htm (last visited Jan. 28, 2007).

113 Fisher & Bauer, *supra* note 112. The theory is supported in part by the beliefs of the indigenous populations who viewed the sky as a male god "fertilizing" the female Earth. The catchments were formed to resemble the female form.

114 Fisher, *supra* note 111.

115 Fisher & Bauer, *supra* note 112.

116 Jodi Torpey, *Law Throws Wet Blanket on Rainwater*, THE DENVER POST, May 27, 2005, at L8; *see also* Colo. Div. of Water Res., Graywater Systems and Rainwater Harvesting in Colorado (2003), http://www.denverwater.org/drought/pdfs/GraywaterRainwater_Harvesting.pdf (last visited Jan. 28, 2007) (noting that use of water in Colorado is governed by the prior appropriation doctrine); *see supra* note 94 and accompanying text.

117 *See* Torpey, *supra* note 116 (noting this is simply a matter of "discretion in enforcing the water law").

fact that, particularly in the arid portions of the state, much of the rain that falls evaporates long before it reaches any surface water source. Complicating the use of rainwater further, a citizen attempting to comply with state law will face a morass of administrative and legal barriers, including local and state building codes, zoning laws, plumbing restrictions, environmental standards, and others.[118]

In other areas of the West, rainwater harvesting has re-emerged. Some might remember their grandparents using rain barrels to collect rainwater to water a small garden or a lawn; the technique is very basic and cheap. It consists of little more than placing buckets under the gutter downspouts—more elegant models might have custom fittings that connect gutters to large drums with faucets at the bottom of the barrel to use water pressure to spray the desired area. Even in an area as wet as Tacoma, Washington there is a growing demand for rain barrels. There, a man named Dan Borba began a small rain barrel business and has become Tacoma's unofficial rain barrel man.[119] When the county gets a call about rainwater harvesting, they pass the caller on to Mr. Borba, whose experimentation with his roof and gutters led him to realize that he could capture over 10,000 gallons of water a year with a roof the size of a two-car garage.[120] He reuses 55 gallon barrels from a local pickle plant along with salvaged hoses and faucets from a local hardware store, and charges $35 for his barrels.[121] Mr. Borba is not driven by profit, but by the power of the idea of harvesting rain and its potential conservation benefits,[122] a passion we all would benefit from. The state of Washington has responded to the emerging use of rainwater harvesting by allowing new or remodeled commercial buildings that include a rainwater harvesting system a reduction in local storm water and surface water management fees.[123]

The rain barrel is a great way to begin thinking about and experimenting with rainwater harvesting and water self-reliance—perhaps a way to jog the memory. However, rain barrels will likely not be large enough to sustain a garden or a lawn through the dry season. A family in Portland, Oregon took the next step and built a water collection system that captures enough rainwater to supply all the water the family requires.[124] They spent $1,500 on

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118 R. WASKOM, COLO. STATE UNIV. COOP. EXTENSION, GRAYWATER REUSE AND RAINWATER HARVESTING (2006), http://www.ext.colostate.edu/pubs/natres/06702.html (last visited Jan. 28, 2007). Such barriers are not limited to Colorado.

119 Rob Carson, *Water Crisis Spurs Tacoma, Wash., Man to Make Rain Barrels*, THE NEWS TRIBUNE, Aug. 6, 2001, at EG.4.

120 *Id.*

121 *Id.*; *see* Dan Borba, Start Harvesting Rainwater Today, http://www.naturalrainwater.com (last visited Jan. 28, 2007).

122 Carson, *supra* note 119.

123 WASH. REV. CODE §§ 35.67.020, 35.92.020 (2006) (stating that when determining rates to charge water conservation achievements can be taken into account).

124 Ole Errson, Rainwater Harvesting and Purification System, http://www.rwh.in (last visited Jan. 28, 2007). This technique is not limited to wet areas like Portland. A family in Billings, Montana—who discovered the proverbial well was dry on the land they purchased—built and maintains a very similar system supplying all their needs. *Billings Couple Feels Satisfaction with Home's Catchment System*, U.S. WATER NEWS ONLINE, Sept. 2004, http://www.uswater news.com/archives/arcconserv/4billcoup9.html (last visited Jan. 28, 2007).

the entire system, which provides over 27,000 gallons (approximately 3,600 cubic feet) of water per year using a rooftop catchment roughly 1,200 square feet in size.[125] The system utilizes a cistern only 1,500 gallons in size, and uses a simple tandem of particulate and ultraviolet filters to make the water suitable for drinking and all other household uses.[126] The family is sharing the successes of their rainwater harvesting techniques on a website containing design specifications, merchant supply contacts, and photos of the system.[127] They enjoy such interesting benefits as not needing hair conditioner or fabric softener because rainwater is so much softer (free of salts and minerals) and enjoy the distinct pleasure of showering in the rain.[128]

The City of Portland is learning that the benefits of rainwater harvesting are not limited to domestic uses. As a part of the city's effort to help the mistreated and heavily polluted Willamette River that runs through the heart of the city, Portland is constructing bioswales in areas that are mostly concrete which normally carry storm water runoff directly into the river.[129] Bioswales create porous areas in the concrete jungle to allow water to settle into the ground where it will be filtered of pollutants as it percolates into the water table.[130] Portland also started creating "rain gardens" which capture rainwater and runoff and filters it through stones, sediment, and natural microbes designed to clean the water.[131] The gardens look like well-landscaped ponds and are often placed at one end of a contoured parking lot or at the base of a downhill street.[132] The city also now has more than 42,000 buildings which are disconnected from the storm sewer system, flushing rainwater over gardens for example, keeping over one billion gallons of storm water out of the Willamette.[133]

The resurgence in rainwater harvesting efforts is not limited to the wettest states in the western United States; Arizona, New Mexico, and Texas are each taking strides to integrate rainwater harvesting into their respective water policies, demonstrating important avenues for government cooperation with community efforts to conserve water.

In Arizona, problems associated with rapid population expansion coupled with aridity and the shortfalls of their centralized programs have forced the state to consider all potential sources which might augment its water supply. The state, along with local engineers and architects, is experimenting with rainwater harvesting and graywater reuse at two major project sites designed to measure domestic water uses and the effectiveness of capture and reuse methods.[134] Casa del Agua is a Tucson residence test site that was retrofitted

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125 Errson, *supra* note 124.

126 *Id.*

127 *Id.*

128 Ruth Mullen, *Savings from a Rainy Day*, THE OREGONIAN, July 24, 2003, at H&G 11.

129 Spencer Heinz, *The Work of the Rain Catchers*, THE OREGONIAN, July 7, 2004, at E1.

130 *Id.*

131 *Id.*

132 *Id.*

133 *Id.*

134 Joe Gelt, *Home Use of Graywater, Rainwater Conserves Water—and May Save Money*, ARROYO (Water Res. Research Ctr., Tuscon, Ariz.), Summer 1993, http://ag.arizona.edu/

to capture rainwater and to reuse graywater in conjunction with landscaping utilizing drought resistant plants.[135] In addition to the basic rainwater harvesting techniques already discussed, Arizona is experimenting with reuse of graywater, which is water from the "bath, shower, washing machine, and bathroom sink."[136] Graywater may be reused to flush toilets or to water gardens or for outside landscaping, instead of simply flushing it away as effluent.[137] The Desert House, an experimental "green" home set in the Phoenix Desert Botanical Gardens, is another test site which is experimenting with energy and water efficiency.[138] The rainwater harvesting components consist partially of contoured roofing to direct rain to plants around the home, using earthen berms to ensure that the water settles at the base of the plants.[139] The home also employs a sand filter to clean rainwater and stores it in a 4,700 gallon cistern for additional landscape watering.[140]

In addition, the University of Arizona has produced a document detailing many simple methods of rainwater harvesting for landscape uses that can help the ground retain moisture.[141] This publication contains calculations for predicting rainwater harvesting totals by area of catchment for Tucson and Phoenix.[142]

New Mexico has followed much the same path, researching rainwater harvesting and providing its citizens with helpful guidance in pursuing water conservation. A public-private partnership has built a house just outside Santa Fe very similar to the Arizona projects to study rainwater harvesting and graywater reuse techniques.[143] The Partnership for Advancing Technology in Housing (PATH) monitored the site for over a year, and issued a detailed report that allows the public to review the system designs, to see how PATH built the home in accordance with local building codes, and to assess the results of the program.[144] In Albuquerque, the city has issued a comprehensive

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AZWATER/arroyo/071rain.html (last visited Jan. 28, 2007) (discussing rainwater harvesting and experimentation in Arizona including both practical and legal issues).

135 *Id.*

136 *Id.* This is contrasted with blackwater, which contains organic material, such as water from toilets and garbage disposals. *Id.* This publication gives a detailed look at the pros and cons of reusing graywater. *Id.* People interested in such uses should be sure to research local regulations, as many states prohibit or harshly regulate the reuse of graywater. *See, e.g.*, ARIZ. ADMIN. CODE § R4-48-125 (2006); N.M. CODE R. § 20.7.3.810–811 (2005); S.D. ADMIN. R. 74:53:01:38 (2006); 30 TEX. ADMIN. CODE § 210.83 (2006); FLA. ADMIN. CODE ANN. R. 64E-6.013 (2006).

137 Gelt, *supra* note 134.

138 *Id.*

139 Desert Botanical Garden, The Desert House: Rainwater Harvesting, http://www.p2pays.org/ref/16/15593/center_dl/rainwater_harvesting.html (last visited Nov. 9, 2006).

140 *Id.*

141 *See* PATRICIA H. WATERFALL, HARVESTING RAINWATER FOR LANDSCAPE USE (2d ed. 2004), *available at* http://cals.arizona.edu/pubs/water/az1344.pdf.

142 *Id.* at 25–27.

143 *See* Allan J. Heavens, *Test House in Santa Fe, N.M., Incorporates Water-Conservation Methods*, PHILADELPHIA INQUIRER, Aug. 17, 2003.

144 *See generally* U.S. DEP'T OF HOUS. & URBAN DEV., FINAL REPORT FOR FIELD EVALUATION OF PATH TECHNOLOGIES (Oct. 2004), *available at* http://www.toolbase.org/pdf/fieldevaluations/ChapmanFinalReport.pdf.

publication very clearly outlining many rainwater harvesting techniques from simple to complex and demonstrating supply calculations for many New Mexico cities.[145]

Perhaps the most impressive cooperative strides by communities and governments in the United States to utilize and encourage the use of rainwater harvesting have been in Texas. Like many other states in the southwest, Texas is growing and struggling with a limited water supply.[146] Texas hosts a wide variety of rainwater harvesting projects similar to those in New Mexico and Arizona,[147] but one of the most interesting is in Austin, Texas. Austin is the home of the American Rainwater Catchment Systems Association (ARCSA), a consortium of professionals, government officials, and academics committed to supporting rainwater harvesting efforts in Texas and throughout the United States.[148] ARCSA provides resources to educate those wanting to design rainwater harvesting systems, hosts a forum for discussing rainwater harvesting issues that includes an on-line newsletter and several conferences, posts extensive lists of suppliers, and maintains a list of publications on rainwater harvesting.[149] Working with the city of Austin, ARCSA and others managed to create a rebate program for rainwater harvesting in the city whereby commercial or residential water customers can get up to a $500 refund from the city for approved rainwater harvesting systems.[150] Following Austin's lead, Hays County, Texas, became the first county in the nation to provide a tax incentive program to support the development of rainwater harvesting.[151] The county provides a $100 rebate for any approved rainwater harvesting application and allows a property tax exemption equivalent to the total value of the rainwater harvesting system installed.[152]

The State of Texas is also involved in promoting rainwater harvesting. In 2001, the Texas Legislature created an exemption from state taxes for rainwater harvesting equipment and supplies,[153] in addition to several research related tax exemptions for rainwater harvesting.[154] Perhaps most impressive,

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145 CITY OF ALBUQUERQUE, RAINWATER HARVESTING: SUPPLY FROM THE SKY, *available at* http://www.ose.state.nm.us/PDF/Publications/Brochures/rainwater_harvesting.pdf.

146 *See generally* Jan Gerston, *Rainwater Harvesting: A New Water Source*, 3 TEX. WATER SAVERS 2 (Tex. Water Res. Inst., Texas), Spring 1997, at 1–9, http://twri.tamu.edu/newsletters/TexasWaterSavers/tws-v3n2.pdf (last visited Jan. 28, 2007) (describing some of the water challenges Texas faces and the rainwater harvesting efforts it has embraced to help address them).

147 TEX. WATER DEV. BD., THE TEXAS MANUAL ON RAINWATER HARVESTING 2–3 (3d ed. 2005), *available at* http://www.twdb.state.tx.us/publications/reports/RainwaterHarvestingManual_3rdedition.pdf.

148 *See* Am. Rainwater Catchment Sys. Ass'n, Welcome to ARCSA, http://www.arcsa-usa.org/ (last visited Jan. 28, 2007).

149 *See id.*

150 *Rebates, Tax Incentives and Exemptions*, 4 ARCSA NEWSLETTER 1 (Am. Rainwater Catchment Sys. Ass'n.), Mar. 2001, at 1, *available at* http://www.arcsa-usa.org/documents/newsletter_vol4_no1.pdf.

151 *Id.* at 2.

152 *Id.*

153 TEX. TAX CODE ANN. § 151.355 (2003)

154 *See* TEX. EDUC. CODE ANN. §§ 44.901, 51.927, 61.0591 (2003) (providing three examples of research related Texas tax exemptions for rainwater harvesting).

the Texas Water Development Board—established by the State of Texas to assist in policy planning and public education toward the responsible development of water in Texas[155]—has issued what seems to be the most comprehensive publication by a public institution analyzing rainwater harvesting benefits, technologies, design characteristics, and potential applications.[156] This document notes that the Texas Legislature has created a rainwater harvesting evaluation committee to report to the legislature its recommendations for the general application of rainwater harvesting in Texas by December of 2006.[157]

These stories of remembrance demonstrate that rainwater harvesting has a place—whether a society faces immediate or eventual shortages due to drought or overextraction. India's efforts were the response to a lack of water which unraveled the basic fabric of life in many rural communities, and their response is understandably communal. Efforts in the United States, because absolute water shortages have not been widespread, are generally more individual and fragmented, but prove that rainwater harvesting has its place in our homes and cities. Lessons from both prove that rainwater harvesting is adaptable. From small-scale to large, individual to community, rainwater harvesting can be integrated at home, on the farm, at the office, into urban planning, and in watershed management.

IV. RECOMMENDATIONS, LARGE AND SMALL

The idea of harvesting the rain is simple, but the various ways this simple idea can be deployed around the world are numerous. This Part offers only preliminary suggestions for incorporating rainwater harvesting into modern water management.

Reviving the ancient wisdom and practice of collecting rain from the sky can be a direct and viable way of meeting water needs in places as different as Alwar and Albuquerque. The common starting point is simply to remember the rain. Remember that all of the useable freshwater on Earth comes from the sky.

Early residents of arid lands understood this—from southern India to the southwestern United States, from China to Central America—perhaps better than many people do today. If you look out your window when it rains, you will understand both the sense and the nonsense of it all: your roof catches the rain, just like the leaf of a plant. The leaf channels the rain to the plant's roots for immediate use, and to natural holding tanks in rivers and lakes and the ground. Your gutters and streets and sidewalks instead channel the rain away from you and away from nature itself, to sewers and treatment plants. After being transformed by human engineering, the rain comes back to you in a pipe, ready to water your grass, wash your car, flush your toilet, . . . or to drink.

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155 Tex. Water Dev. Bd., TWDB History, http://www.twdb.state.tx.us/about/history.htm (last visited Jan. 28, 2007).

156 *See generally* TEX. WATER DEV. BD., *supra* note 147.

157 *Id.* 43–44.

Incorporating rainwater harvesting into existing water use policies would foster the responsibility for living life more in balance with the natural cycle, both as individuals and as communities. Listen "to your elders, to the river, to the wind, to the earth, to the animals."[158] Listen to the rain. Anyone can easily play a part. Homeowners can use rain barrels to collect water for the garden or the lawn. Landowners can use bioswales and maintain vegetation in riparian areas to slow and filter runoff. Farmers can use catchments to reduce irrigation needs and to revitalize over-appropriated rivers, streams, and aquifers.

Remembering, rethinking, and listening to the rain can prompt an international exchange of ideas and experience. What lessons from the Avari River watershed in India might serve the dwindling Colorado River? Could a system of small check dams along the river mean more fertile fields, retaining more water and requiring less wasteful irrigation? With greater retention, more water would reach the water table, supporting the river itself and those who depend on wells for drinking water. *More water* because less is lost. What applications might improve U.S. agricultural policy? Perhaps instead of subsidizing farmers to leave millions of acres fallow each season[159] or to grow low value crops just to keep the fields in production,[160] we might subsidize the use of fields as catchments, employing recharge pits to help water percolate into the water table—moisture farmers, so to speak.

The list of potential applications goes on, but a broad and systematic development of rainwater harvesting techniques will require both education and governmental support. The remainder of this Part briefly explores each of these in turn.

A. Education

Many individuals and communities worldwide are already aware of the rainwater harvesting revival and may even be motivated to join it. The worldwide web is a perfect tool for disseminating useful information and technical advice to interested do-it-your-selfers on how to use rainwater harvesting in various locales. In fact, many existing websites already provide a wealth of self-help suggestions and techniques, including suggested project designs.[161]

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158 Getches, *supra* note 31, at 2.

159 *See* David Farrier, *Conserving Biodiversity on Private Land: Incentives for Management or Compensation for Lost Expectations?*, 19 HARV. ENVTL. L. REV. 303, 329–30 (1995) (explaining that the Conservation Reserve Program of the federal Farm Bill pays landowners "to let their land lie fallow").

160 Laura D'Andrea Tyson, *The Farm Bill Is a $200 Billion Disaster*, BUS. WK. ONLINE, June 3, 2002, http://www.businessweek.com/magazine/content/02_22/b3785037.htm (last visited Jan. 28, 2007).

161 *See, e.g.*, TEX. WATER DEV. BD., *supra* note 147; Am. Rainwater Catchment Sys. Ass'n, *supra* note 148; HarvestH_2O.com: The Online Rainwater Harvesting Community, http://www.harvesth2o.com/ (last visited Jan. 28, 2007); Gretchen Rupp, *Rainwater Harvesting Systems for Montana*, MONTGUIDE (Mont. Water Ctr., Bozeman, Mont.), Nov. 2006, http://www.montana.edu/wwwpb/pubs/mt199707.pdf (last visited Jan. 28, 2007).

The information that is sometimes missing from these sites, however, is adequate guidance on applicable laws, such as water use laws, building codes, water quality regulations, and other rules that might constrain or, on the other hand, encourage the practice of rainwater harvesting.[162] Who might provide that missing piece? Water suppliers themselves could be proactive about promoting appropriate use of rainwater collection as a credible component of the overall water supply package in the same way that electric utilities have become more active in promoting conservation and alternative energy sources as an important part of the overall energy supply portfolio. After all, water suppliers are the entities charged with projecting water needs and developing supply plans to meet those needs. In this day and age, with potential water shortages receiving considerable publicity, responsible water utilities should be considering the widest possible range of options for their supply portfolios.[163] Part of investigating all available options should include posing basic questions about whether the best practices in water management require large, engineered water projects designed to deliver clean, drinkable water to all customers for all purposes or whether water supplies could be more closely matched to their intended uses. Such an approach would allow the purest (and most expensive) water to be used where necessary, but would allow more easily-obtained (and much less costly) graywater to be used for many less-sensitive purposes.

In addition to water utilities, municipalities should also be important players in rainwater harvesting education. In some areas, water supply utilities and municipalities are one and the same entity, but in many places these functions are not consolidated.[164] Even cities that are not in the water supply business ought to take an interest in educating the public about the promises and perils of rainwater harvesting because of their responsibilities for land use laws, building codes, stormwater management, and sanitation. Some cities already broadly construe their responsibilities to include education and assistance about sustainable development practices for a variety of reasons, including saving money, reducing environmental impacts, and stretching existing natural and financial resources further. For example, the City of Portland, Oregon, has an Office of Sustainable Development that, among other things, promotes "green" building and landscaping practices.[165] At the time of

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162 Some sites do provide guidance on the applicable legal requirements. *See, e.g.*, N.M. Env't Dep't, Liquid Waste (Septic Tank) Program Gray Water Info., http://www.nmenv.state.nm.us/fod/LiquidWaste/graywater.html (last visited Jan. 28, 2007); Gelt, *supra* note 134.

163 *See, e.g.*, Dan Vergano, *Water Shortages Will Leave World in Dire Straits*, USA TODAY, Jan. 26, 2003, at 9D (explaining that the United Nations Environment Programme published a report stating that half of the world's population "will be living with water shortages, depleted fisheries and polluted coastlines within 50 years because of a worldwide water crisis").

164 *Compare* Portland Water Bureau, http://www.portlandonline.com/water (last visited Jan. 28, 2007) (the water supply utility in Portland, Oregon is a city bureau), *with* Springfield Utility Board, http://www.subutil.com (last visited Jan. 28, 2007) (the water and electricity utility in Springfield, Oregon is community-owned).

165 *See, e.g.*, City of Portland, Office of Sustainable Development, About Us, http://www.portlandonline.com/osd/index.cfm?c=41463 (last visited Jan. 28, 2007) (describing the office's mission and programs as seeking "to provide leadership and contribute practical solutions to ensure a prosperous community where people and nature thrive, now and in the

this writing, the office's web-based calendar of events contained a number of educational workshops, classes, and presentations, including sessions on building eco-roofs and reducing stormwater runoff.[166] The site also contained specific advice about rainwater harvesting, noting that no permits are needed to collect and use rainwater outside a building and providing information about how to seek a permit to use rainwater for indoor domestic purposes.[167]

University extension programs are another logical educational provider. In the United States these programs provide information and technical assistance to farmers, forest land owners, gardeners, and others about practices to conserve soil and water, among other things.[168] Indeed, several university extension programs around the country do in fact include information about rainwater harvesting among their materials.[169]

For the most part, however, all of these educational resources described so far will be found only by fairly motivated seekers who are specifically looking for the information and who are both net-savvy and persistent in navigating the available online sources. A completely different educational approach is required to get the word out about the value and validity of rainwater harvesting more generally. A broader educational effort needs to start with some very basic principles of natural science. We need to take a look around us and remember that we live not in a virtual world, but in a very real world, and that the real world consists of natural cycles, natural limits, and natural resources that we take for granted at our peril.

One of the ironies of modern life in highly industrialized countries is our increasing disconnection from the natural world.[170] In the United States, water comes from the faucet, food comes from the grocery store, and lumber comes from a "big-box" store. We have little appreciation for the real source of those goods, and even less appreciation for the functioning natural systems required to keep producing them. In contrast, populations in less-industrialized nations, particularly rural residents, may be all too aware of nature's role in their lives, as many face drought, famine, and disease. Yet these populations may not appreciate the hows and whys of their scarcity predicament any better than wealthy populations appreciate the underpinnings of their abundance.

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future" and to "deliver[] policy and programs that integrate efforts related to energy efficiency, renewable resources, waste reduction and recycling, global warming, green building and sustainable food systems").

166 *Id.* (search for "ecoroofs").

167 *Id.* (search for "rainwater harvesting").

168 *See, e.g.*, Or. State Univ. Extension Serv., About Us, http://extension.oregonstate.edu/about/programs.php (last visited Jan. 28, 2007); Univ. of Mo. Extension, Drought, http://muextension.missouri.edu/drought/ (last visited Jan. 28, 2007).

169 *See, e.g.*, Wash. State Univ. Extension, Videostreaming, http://caheinfo.wsu.edu/video/stream.html (last visited Jan. 28, 2007) (describing a video that addresses harvesting rainwater entitled STORMWATER MANAGEMENT FROM A WATERSHED PERSPECTIVE: EXTREME WESTERN CLIMATES).

170 Troy Payne, *Cartesian Eco-Femdarkanism: She Comes from the Earth, Therefore We Are*, 37 ENVTL. L. 201, 207–12 (2007). *See generally* RICHARD LOUV, LAST CHILD IN THE WOODS: SAVING OUR CHILDREN FROM NATURE DEFICIT DISORDER (2005) (describing how children have become disconnected from the natural world, living a "denatured childhood").

Basic education about water resources, the hydrologic cycle, and watershed functions could benefit rich and poor countries alike. In richer countries, such education could perhaps instill a modicum of humility and caution about the limits of natural systems to support excessive consumption levels indefinitely. In poorer countries, conversely, the results of teaching about watershed function and hydrology might be empowerment and self-determination, in order to move toward necessary and adequate consumption levels. As the saying goes, knowledge is power, and at both extremes, watershed education could enable communities to take charge of their water futures.

Water cannot be isolated from the rest of nature, of course, so "watershed" education really means teaching about the basic earth sciences, the natural environment, and ecosystem processes more broadly. Although teaching about the natural world and its support for human life seems hard to argue with, in fact, this suggestion will be controversial. In the United States, extractive industry groups have already attacked environmental education in public schools as inappropriately promoting a radical environmental agenda.[171] But teaching about how the natural world works hardly seems radical, nor does it equate with advocacy of any particular policy positions. We do not exist in a "human bubble" apart from nature, bounded only by human ideas and engineering. We live in a world of dirt and water, plants and animals, droughts and floods. Understanding the functioning of that world is just as basic to the health and wealth of our future society as the traditional basics of reading, writing, and arithmetic.

Education is only the beginning, however. Fully developing rainwater harvesting as a viable component of water supply and use will require more than teaching basic natural science education and making useful information available to interested parties. Water management policy is made largely in legislative halls and agency offices, and that is where policy changes need to occur as well.

B. Government Support for Rainwater Harvesting

Thomas Paine has been attributed with the phrase "[l]ead, follow, or get out of the way."[172] This expression concisely captures the variety of roles that government can play in the rainwater harvesting revival.

First and foremost, government can lead the effort by modeling rainwater harvesting in government buildings and on other public property, and by actively pursuing law and policy changes to promote rainwater

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171 *See generally* MICHAEL SANERA & JANE S. SHAW, FACTS, NOT FEAR: A PARENTS' GUIDE TO TEACHING CHILDREN ABOUT THE ENVIRONMENT (1996) (described on the Recommended Reading List of the Associated Oregon Loggers' website as "[a] guidebook to help parents counter the irresponsible claims of environmental extremists--giving children a more balanced view of environmental issues").

172 *See* QuoteDB, http://www.quotedb.com/quotes/1738 (last visited Jan. 28, 2007); *but see* Wikipedia, List of Famous Misquotations, http://en.wikipedia.org/wiki/List_of_famous_misquotations (last visited Jan. 28, 2007).

harvesting. One story from India illustrates just how powerful true governmental leadership can be in promoting changes in water use. In Tamilnadu, a state on the southern tip of India, the state government has aggressively promoted rainwater harvesting. In 2001, the Honourable Chief Minister of Tamilnadu, Dr. J. Jayalalithaa, announced in an Independence Day speech that "[r]ainwater harvesting will be accorded prime importance. All water bodies like tanks, ponds, lakes, and temple tanks, in rural and urban areas will be renovated to serve as rainwater harvesting structures."[173] Two years later, an ordinance was adopted that made rainwater harvesting mandatory for all buildings in the state.[174] The ordinance set a short deadline and specified that for any buildings missing the deadline, the state would provide the necessary structures and then recover the cost from the owner as a property tax.[175] Not long after, the state expanded the effort to include roads and open spaces as well.[176]

Significantly, the government of Tamilnadu led by example, equipping government buildings with rainwater harvesting devices. In fact, even before the ordinance was adopted, the Chief Minister fitted her own residence with harvesting equipment, and major government buildings soon followed, including that of the Tamilnadu Water Supply and Drainage Board.[177] By October of 2003, nearly two million government buildings, more than 48 million non-governmental urban buildings, and nearly 67 million rural buildings were equipped for rainwater harvesting, and over 2.5 billion non-building projects had also been completed.[178]

The Tamilnadu effort was a multi-pronged approach including education and action, planning and monitoring, mandates and incentives, and high-tech and low-tech components. The government put together a comprehensive educational campaign designed to reach "every citizen, community, NGO, educational institution, private organization and government body" with the message of rainwater harvesting.[179] The campaign employed every possible medium, including direct mail, print media, broadcast media, billboards, seminars, and workshops.[180] The Chief Minister also created awards programs to motivate everyone from politicians to school children.[181] The Water and Drainage Board uses state of the art remote sensing technology, rainfall data, and GIS mapping to determine the best areas for particular devices, and then monitors project success with observation wells and other data collection processes.[182] In

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173 Tamilnadu Water Supply & Drainage Bd., Rain Water Harvesting 7, http://www.about rainwaterharvesting.com/rwhviable.pdf (last visited Jan. 28, 2007).

174 *Id.* at 7–8.

175 *Id.* at 8.

176 *Id.*

177 *Id.* at 11.

178 *Id.* at 13.

179 *Id.* at 8.

180 *Id.*

181 *Id.* at 10.

182 *Id.* at 3.

rural areas, women's "self-help groups" and other community organizations participated both in starting projects as well as educating their neighbors.[183]

The Tamilnadu experience is nothing short of amazing. Less than five years after the Chief Minister's 2001 speech, the state has achieved 100% coverage of all buildings across a geographic area of 130,000 square kilometers containing 62 million people, slightly more than half living in rural areas.[184] The government aggressively confronted a several-year water crisis created by drought, population growth, poor water management, and falling water tables in significant part by reviving rainwater harvesting, which "though traditional, ha[d] over . . . time been ignored."[185] By recognizing that "[r]ain is the ultimate source of fresh water" and declaring the "urgency to implement rainwater harvesting to conserve every precious drop of rain," the Chief Minister and her government set out to "make Tamilnadu a water bountiful state." [186] Results from the monitoring programs already show an average rise in the water table of more than two meters.[187] The Tamilnadu government led by example and with education as well as legislation, and "[t]he government order became a people's movement." [188]

American states and other governmental entities around the world could readily follow Tamilnadu's example. Adopting merely a portion of the Indian state's ambitious plan would be a significant act of leadership, going a long way toward reviving the common sense practices of rainwater harvesting. But even if a governmental entity lacks the resources, political will, or authority to take such an ambitious leadership role, a government can take other significant steps.

Specifically, government water regulators should recognize that not all end-uses require potable water. Both public and private water utilities should be required to include water conservation, water re-use, and rainwater harvesting in their planning for future water supplies. Water needs range across a very broad spectrum. Human consumption, health care, and computer chip manufacturing, for instance, require high quality water. Irrigation, street cleaning, car washes, cooling towers, and many industrial processes, on the other hand, do not need potable water. The full spectrum of water needs should be met by an equally broad range of supply choices instead of a one-size-fits-all highly-treated water supply. Building flexibility into the supply end of the water pipe, though perhaps entailing some upfront costs for retrofitting, could meet water needs at far less total cost and with less environmental impact than the current inflexible approach. Viewing rainwater capture as an integral part of water supply also requires confronting the issue of lost revenues from allowing water users to go "off the grid." Currently, water suppliers charge customers for water delivery, and the utility needs a certain number of customers to cover its overhead expenses and sunk

183 *Id.* at 12.
184 *Id.* at 3, 16.
185 *Id.* at 5.
186 *Id.* at 2–3.
187 *Id.* at 15.
188 *Id.* at 13.

costs. Suppliers may therefore be concerned about letting customers go because of the lost revenue in the short term, even though the long-term savings could be significant. This issue needs to be confronted directly and early in order to fully develop real information on costs and benefits.

Another act of governmental leadership would be to require public bodies responsible for water supply, stormwater management, sanitation and sewage treatment, water quality regulation, land use planning, and building and landscaping codes to work together on a plan to manage rainwater and runoff comprehensively. Currently, all of these responsibilities are spread across many different agencies with different missions and mandates. The officials who are worrying about stormwater management could benefit greatly from reducing runoff, and those planning for future drinking water needs would benefit from aquifer recharge, but they cannot accomplish those goals without the help of land use planners and building code drafters. Governmental officials at a higher level (governors' and mayors' offices, for instance) need to provide the impetus or mandate for the different agencies to work together. Offices of "sustainability" are a logical place to put this coordinating responsibility, as long as those offices have sufficient authority to do the job.

Governmental bodies may choose to "follow" the burgeoning rainwater harvesting revival rather than lead the effort. A follower or supporting role might simply consist of serving as a clearinghouse to provide good information to parties interested in rainwater harvesting, along the lines described in the education discussion above.[189] Government water utilities and building permit agencies should make it easy for motivated individuals and businesses to find the information they need to pursue projects, including clear guidance on what can or cannot be done under current laws and what permits are needed.

Government can also "follow the money" or rather follow *with* money, by offering financial incentives to encourage and support experimentation by motivated private parties, NGOs, and community groups. The examples of tax breaks, water bill rebates, and research grants in Texas and New Mexico are straightforward, fairly low-cost options for government to support rainwater harvesting without taking an aggressive leadership role.[190]

At the very least, government can "get out of the way" and let rainwater harvesting develop of its own volition by removing barriers to the practice. One way to do this is for regulatory bodies to consider whether existing water allocation laws unnecessarily prohibit small-scale rainwater harvest. Most American states appropriately proclaim that all water resources within the state belong to the public, but states may differ on how they define the universe of water resources.[191] Some states explicitly provide that "diffuse"

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189 *Supra* notes 159–68 and accompanying text.

190 *Supra* notes 147–52; Albuquerque Official City Website, Rainwater Harvesting Barrel Rebate, http://www.cabq.gov/waterconservation/rainwater.html (last visited Jan. 28, 2007).

191 *See, e.g.*, COLO. REV. STAT. § 37-82-101 (2006) (describing surface flows subject to appropriation); *id.* § 37-82-102 (describing priority of spring flows); *id.* § 37-95-103(14) (defining water resources for purposes of water resources and power development).

surface water (essentially runoff moving over the ground rather than in a channel) belongs to the owner of the property on which it occurs.[192] This approach would seem to allow rainwater harvesting.

To the extent that a state attempts to assert control over water from the very moment of precipitation, however, even the most minor use by homeowners or landowners could be problematic. As noted earlier, in Colorado, rainwater harvesting would seem to be essentially illegal. We would not presume to suggest that Colorado's water laws are misguided, but the state might consider whether its ban goes further than it needs to in effecting Colorado's declaration of ownership and control of the state's water. Perhaps asserting control over all of the precipitation which falls within Colorado's borders is integral to the state's comprehensive regulation of water allocation generally, but it might also be possible—and even beneficial—to carve out some small exceptions for small-scale rainwater harvesting projects.

In other states, barriers to capturing and using rainwater may not be so explicit, but they can still be problematic. For instance, current water quality regulations assume that all water supplied to a residence must meet drinking water standards.[193] And most building and landscaping codes treat runoff as something to be whisked away to storm sewers as quickly as possible, instead of a resource to be husbanded and used.[194] These existing laws present hurdles to attempting rainwater harvesting, no matter how interested an individual or business might be.

Water laws already exempt certain water uses from the water rights permitting process, such as domestic wells or surface diversions up to a specified amount of water.[195] Similar exemptions could be extended to "captured" water as well. By tying in to existing exempt uses and exempt amounts of water, states could avoid the specter of rainwater harvesting being used as a loophole to acquire large amounts of water outside of the water rights permit system.

Another way of removing unnecessary barriers to rainwater harvesting would be to integrate permitting for rainwater capture projects fully into existing permit processes to avoid creating a separate layer of applications, permits, and costs. Residential projects should be clearly provided for in building codes; roadside bioswales should be built into transportation

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192 *See, e.g.*, OR. REV. STAT. § 537.141(1)(e) (2005).

193 *See, e.g.*, OR. ADMIN. R. 333-061-0025 (2006) ("Water suppliers are responsible for taking all reasonable precautions to assure that the water delivered to water users does not exceed maximum contaminant levels.").

194 *See* TOOLBASE SERVICES, LOW IMPACT DEVELOPMENT PRACTICES FOR STORM WATER MANAGEMENT, http://www.toolbase.org/Techinventory/TechDetails.aspx?ContentDetailID=909&BucketID=6&CategoryID=11 (last visited Jan. 28, 2007) (explaining "that local building requirements often require developers to take an 'end of pipe' approach," and "storm water drains do not typically channel water to treatment facilities").

195 *See, e.g.*, OR. REV. STAT. § 537.545 (2005) (exempting domestic uses up to 15,000 gallons per day from groundwater, including domestic wells); S.D. CODIFIED LAWS § 46-5-8 (2004) (exempting domestic wells and surface diversions for domestic use from the permit system); WASH. REV. CODE § 90.44.050 (2006) (exempting groundwater and surface water diversion from permitting requirements for domestic and other use).

planning and permitting; agricultural projects need to be incorporated into existing soil and water conservation efforts. The goal is to make doing the right thing easy instead of difficult.

Lead, follow, or get out of the way. In any of those ways, governmental bodies can help the rainwater harvesting revival flourish. Governmental entities from all over the world can choose from a menu of options, ranging from simpler activities like providing information and removing legal barriers to more active roles such as offering financial incentives or directly promoting and implementing rainwater harvesting. With wise water management as the desired end, and unapologetic natural science education and governmental support as the means, we can bring old wisdom to bear on new problems.

Most of us have forgotten how to use the rain, but the clouds keep gathering over our heads, season after season. The rains keep falling, again and again, reminding us—if we're paying attention—of where our water comes from. Many have forgotten, but the rain remembers. Sometimes old ideas become new again: we need to remember the rain.