Thirsty for a Solution: Promoting More Efficient Water Use in the West

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ABSTRACT

The southwestern United States, which produces a large portion of the nation’s food supply, continues to experience severe water scarcity challenges. Although some of this scarcity is due to persistent drought conditions, much of the problem is attributable to shortcomings in the country’s water management policies. Governments in the region increasingly adopt laws seeking to compel residential water users to cut back on water use, yet many farmers continue receiving sizable crop insurance subsidies that effectively encourage wasteful irrigation practices. This Article examines the primary policy factors contributing to the growing severity and persistence of water scarcity problems in the southwestern United States and examines how the federal Farm Bill and water rights laws affect water use in the Southwest. The Article then proposes potential means for addressing these challenges, including revisions to agricultural subsidy programs capable of incentivizing greater water conservation and strategies for adjusting water rights laws to better promote water-efficient irrigation practices.

INTRODUCTION

In recent years, California, suffering under extreme constraints on water supplies, began adopting aggressive policies to encourage or compel residents to cut back on water usage. Although El Niño conditions struck California with great force in the beginning of 2016, bringing some additional moisture into the region, it is increasingly evident that this spike in heavy rainfall will not be enough to remedy the effects of years of ongoing drought. Unless governments embrace substantial policy changes capable of addressing this growing problem, the Southwest’s water challenges could ultimately reduce the quality of life for millions of Americans and weaken the United States’ economy.

Water scarcity has long been a challenge throughout much of the southwestern United States, a region with a naturally arid climate and relatively few large rivers capable of supporting sizeable populations. Accordingly, those who settled the Southwest more than a century ago had to find creative ways to make...

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2. See Anne Brice, The State, the Drought and El Niño—A Complicated Relationship, PHYS ORG (January 15, 2016), http://phys.org/news/2016-01-state-drought-el-nino-compli-cated.html (explaining that California’s groundwater resources are so depleted that higher-than-average precipitation from stormwater will not restore hydrological systems to drought-resistant levels).


the limited availability of water meet their needs. As populations in the region grew and California's agricultural sector matured over time, its irrigation of the limited resource intensified. This discrepancy between water supply and demand could affect the national economy, because California is the leading agricultural state in the country. Population growth, combined with ongoing drought conditions and unsustainable practices, have culminated in a crisis throughout the Southwest that requires proactive governmental intervention.

This Article explores what governments can do to better confront the water scarcity crisis facing California and its neighboring states, and ultimately argues that action should be taken on both the federal and state levels to better prepare the Southwest for risks associated with perpetual drought. Part I describes the severity and primary causes of the water crisis in the southwestern United States, with particular focus on California and the impacts of its agricultural sector on the country's economy. Part I also examines how the federal Farm Bill encourages water waste by insuring farmers against drought-related losses.

Part II explains how amendments to the federal Farm Bill could promote greater water conservation in southwestern farming operations. It specifically highlights four possible policy strategies: limiting some types of crop insurance coverage; creating "droughtbuster" provisions that offer less aid to farmers that grow water-intensive crops in drought-stricken counties; offering grants to farmers who make water-efficient agricultural investments; and establishing "virtual water" import and export standards to monitor improvements in water efficiency. Part III discusses how policy changes could better incentivize agricultural water users to implement water-reducing irrigation practices.

I. A GROWING WATER CRISIS

It is difficult to pick up a newspaper or news magazine today without reading about water challenges in the Southwest. But how did the water situation in California and its surrounding states become so dire? This section describes many of the factors that led to the water crisis and how this threatens the regional and national economy.

A. SEVERE DROUGHT IN AN ALREADY ARID REGION

The agricultural industry is an essential sector of the American economy that supports millions of jobs, especially in the southwestern United States. A recent Census of Agriculture conducted by the United States Department of Agriculture ("USDA") found that nearly $300 billion worth of farm products were sold in 2007, and the near half-million farms across the nation employ approximately 2.5 million people.\

6. ALAN L. OLmSTead & PAUL W. RHoDe, CALIFoRNIa AGRICULTURAL DIMENSIONS AND ISSUES 3 (Jerry Siebert ed., 2003).
8. See Paul Janda, Fire, Flood, Famine, and Pestilence: Climate Change and Federal Crop
From 1950 to 2000, the population in the United States grew by almost 90%. To support the rapidly increasing population, agricultural production skyrocketed, acres of farmland increased by almost 148%, and total water withdrawals rose by nearly 12%. In 2000, the estimated water use for irrigation was 137,000 million gallons daily. Although the demand for water is high, the farms responsible for the majority of water withdrawals for irrigation are located in western climates that are unable to depend on precipitation to grow crops. Despite its unsuitable climate, the agricultural industry in California boomed in large part because its population has almost doubled since 1950. Before the 1988 drought, dubbed one of the most "costly natural disasters" in United States' history, 80% of the available water consumed in California was used for agriculture.

In recent years, mismanagement and overuse of water resources in southwestern states have imposed additional strain on the region's water supply, and California is again experiencing exceptional drought. In 2013, California received less precipitation than any year previously recorded, and 2014 ended as its third driest year. This is likely part of a long-term drought, and relying on groundwater supplies will not be an option. Despite groundwater pumping efforts, there will still be an extreme net water shortage and groundwater pumping costs will escalate. Additionally, the drought will cause estimated losses of

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10. See id.
11. See id. Total water withdrawals include surface and groundwater. Id.
15. See Janet C. Neuman, Drought Proofing Water Law, 7 U. DENV. WATER L. REV. 92, 99 (2003). The most severe part of the drought lasted from 1987 to 1989; total losses from 1988 alone cost over $39 billion, and agricultural relief payment cost more than $7 billion. Id.
17. See Stephanie C. Herring, Martin P. Hoerling, Thomas C. Peterson, & Peter A. Stott, Explaining Extreme Events of 2013 from a Climate Perspective, BULLETIN OF THE Amer. METEOROLOGICAL SOC'Y 84-5 (Sep. 2014).
20. See Howitt, supra note 9 at 3, 10. There was estimated to still be a net water shortage of
over $200 million in dairy and livestock, and approximately $810 million in crop revenue.\textsuperscript{21}

As California’s severe drought continues into 2017, it may lead to even lower groundwater levels, further overdraft of aquifers, increased costs to pump water, depletion of wells, and land subsidence.\textsuperscript{22} Replacing approximately five million acre-feet of surface water with groundwater cost an estimated $447 million dollars in the Central Valley in 2014 alone and an estimated $6.3 million in other parts of California.\textsuperscript{23} If this trend continues, the costs for the Central Valley could rise to almost $460 million for 2016.\textsuperscript{24} Additionally, mining the state’s groundwater could deplete the aquifers, leaving the state with little groundwater resources for the future.\textsuperscript{25} Relying solely on the state’s groundwater supplies instead of reducing water use is a short-sighted practice.\textsuperscript{26}

\section*{B. OTHER CONTRIBUTING FACTORS}

In addition to drought, there are many factors that contribute to the problem of water scarcity. Climate change, animal agriculture, outdated prior appropriation, inefficient irrigation techniques, and the current state of the Farm Bill all hinder efficient water management in the region.

1. Climate Change

Climate change presents a unique challenge to water use and management in arid climates, because dry regions are already vulnerable to irregular water supplies and other inconsistencies that may be amplified by the climate phenomenon.\textsuperscript{27} Although the ultimate effects of climate change on California’s drought are uncertain, higher temperatures and lower precipitation associated with global warming will likely contribute to droughts in the future.\textsuperscript{28} Droughts in the region occur regularly, but dendrochronology suggests that the current drought is the worst California has faced in a thousand years.\textsuperscript{29} Droughts and climate change are undeniably worse together than their effects would be if they occurred alone.\textsuperscript{30} The southwestern United States is particularly prone to

\begin{itemize}
\item 1.6 million acre-feet,\textsuperscript{16} and groundwater pumping costs of $454 million from 2014. \textit{Id.}
\item 21. \textit{Id.} at ii.
\item 22. \textit{Id.} at 2.
\item 23. \textit{Id.} at 3.
\item 24. \textit{Id.} at ii and 3. Robert Howitt estimates these two dry years will cost the California farming industry $1 billion each year and cost the state $2.2 billion with over 17,000 jobs losses.
\item 26. See generally \textit{id.}
\item 27. See Neuman, \textit{supra} note 15, at 98.
\item 28. See \textit{id.} at 96–97.
\item 29. See Julia Fahrenkamp-Uppenbrink, \textit{California drought worst in the past millennium}, SCIENCE (Feb. 6, 2015).
drought, and with the additional impacts of climate change, there is an urgent
need for more comprehensive preparation for potential "megadroughts" in the
region’s future.  

2. Animal Agriculture

Water practices in animal agriculture, especially in California—the third
highest producer of livestock products in the country—contribute significantly
to the Southwest’s water problems.  Livestock production—including the pro-
duction of eggs, meat, and milk—uses one third of the world’s fresh water.  
Global meat production per capita has grown by over 60% since the 1960s as
both a cause and a consequence of industrial-scale livestock production.  
Large-scale meat production facilities efficiently serve the increased demand for
meat, but have environmental consequences that can catastrophically deplete
water reserves.  

Animal agriculture, when practiced unsustainably, threatens ground and
surface water largely due to runoff pollution from animal waste.  Raising and
preparing livestock for consumption requires substantial quantities of water, and
a recent study concluded that producing just one pound of meat requires almost
1,800 gallons of water.  This figure includes water consumed for growing feed
to sustain livestock, for drinking water, and other water used in production.  
In comparison, growing an apple requires eighteen gallons of water.  The current
high demand for water-intensive foods such as meat is unsustainable.  A wider
look at trends in agricultural production suggests that consumer incentives, such
as true-cost pricing and labeling, could help to drive the market towards alter-
native food products.  Lowering the demand for products derived from animal
agriculture may lead to more sustainable levels of production.

3. Prior Appropriation

The doctrine of prior appropriation is another major contributing factor to
problems of water use and conservation in the Southwest.  Prior appropriation

31.  See id. at 1079.
32.  CALIFORNIA AGRICULTURE STATISTICAL REVIEW 2014-2015, CALIFORNIA
DEPARTMENT OF FOOD AND AGRICULTURE 85 (2015).  Texas and Iowa are ranked first and
second in the United States for production of livestock products.
33.  HEATHER COOLEY ET AL., CALIFORNIA’S WATER FOOTPRINT 3 (2012).
34.  See Bryan Walsh, The Triple Whopper Environmental Impact of Global Meat Production
(Dec. 16, 2013), TIME, http://science.time.com/2013/12/16/the-triple-whopper-environ-
mental-impact-of-global-meat-production/.
35.  See David Tilman, et al., Agricultural Sustainability and Intensive Production Practices,
418 NATURE 671, 674 (2002).
36.  Id.
37.  Id. at 674-75.
38.  See Betty Hallock, To make a burger, first you need 660 gallons of water . . ., LA TIMES
(Jan. 27, 2014), http://www.latimes.com/food/dailydish/la-dd-gallons-of-water-to-make-a-burger-
20140124-story.html.
39.  See id.
40.  See id.
41.  See Tilman, supra note 35, at 675.
began as a way to award water rights to users who put water to a beneficial and productive use, such as irrigation, mining, and even generating hydropower. This system of water allocation can result in appropriators ignoring the actual economic and environmental consequences of their actions.

Water users subject to prior appropriation have a disincentive to decrease water use. Prior appropriation water rights are subject to abandonment or forfeiture depending on the jurisdiction. Abandonment requires that an owner intend to abandon water rights and actually abandon them. Under the rule of forfeiture, an owner simply needs to fail to use the water for a statutory period. This 'use it or lose it' policy encourages water rights holders to use their entire allocated amount to prevent their water rights from being diminished or lost. Western agricultural users are thus encouraged to maintain current and often wasteful irrigation practices despite the existence of numerous technologies and practices that allow for more efficient water use.

4. Wasteful Irrigation Practices

Another contributing factor to the Southwest's water scarcity crisis is an abundance of inefficient irrigation practices in the region. Flood irrigation, the most common method of irrigation used in the United States, is also the most inefficient, and is the single greatest consumer of fresh water. The nation's second most common type of irrigation is sprinkler irrigation, which is more efficient than flood irrigation but remains vulnerable to extreme weather conditions such as hot and dry or windy weather. In contrast, micro-irrigation and drip irrigation are the most efficient and sustainable irrigation systems available, but are utilized by less than 7% of total irrigated acres in the United States.

42. See Dept of Parks v. Idaho Dept of Water Admin., 530 P.2d 924, 927-28 (Idaho 1974) (holding the doctrine of beneficial was historically favored certain uses over others, but the definition of beneficial use is not exhaustive); see also Norioan, supra note 9, at 192-93, 201, 203.

43. See Norioan, supra note 9, at 183.


45. See id.

46. United States v. Alpine Land & Reservoir Co., 983 F.2d 1487, 1495 (9th Cir. 1992) (holding that "[t]he only requirement to prove forfeiture of water rights is to show a failure to use the water beneficially for five successive years"); see also Fehlmann, supra note 44, at 17.

47. See Norioan, supra note 9, at 184-85 (explaining that flood irrigation represents approximately 47% of total irrigated areas, with only 60% to 70% efficiency rates) (citation omitted).

48. Id. at 185-86 (explaining that Sprinkler irrigation represents an estimated 46% of irrigated agriculture, with efficiency rates of approximately 80% to 95%) (citation omitted).

49. Id. at 186. California agriculture makes up 72% of this total, but largely due to the fact that it is the country's biggest producer of tree nuts, fruits, and vegetables.

50. Id. (citing HEATHER COOLEY ET AL., PACIFIC INST., SUSTAINING CALIFORNIA AGRICULTURE IN AN UNCERTAIN FUTURE 39-40 (2009), http://pacinst.org/app/uploads/2014/04/sustaining-california-agriculture-pacinst-full-report.pdf (stating that the one of the disadvantages to converting to a drip system is the initial investment. However, the costs can be offset
Implementing existing water-reducing irrigation technologies could greatly reduce the amount of water used in southwestern agriculture. Three practices that could be adopted are subsurface drip irrigation, tailwater return systems, and irrigation scheduling.

i. Subsurface Drip Irrigation

Subsurface drip irrigation ("SDI") has great potential to reduce water waste in southwestern agriculture. SDI is between 25% and 50% more water-efficient than traditional flood irrigation. SDI uses polyethylene tubing or tape to slowly apply water to the crop root zone. SDI systems require less water than sprinkler or surface irrigation because water is applied at the root rather than the surface, so minimal water is lost to evaporation or runoff. The method also makes it possible to safely irrigate with wastewater by preventing human contact, thus lessening demand for potable water resources. SDI not only uses less water, but can even increase crop yields. Additional potential agricultural benefits associated with the practice include reduced labor costs, energy, and fertilizer and pesticide requirements.

SDI has been used in the Southwest for over thirty years, but its adoption has been slow. Unfortunately, SDI requires major up-front investments of financial and other resources. Also, SDI systems require specialized knowledge to function over an extended period time. But with proper management, SDI systems can function for ten or more years. Financial and information assistance would likely help individual farmers overcome these barriers and boost the adoption of SDI.

ii. Tailwater Return Systems

Tailwater return is another water-efficient irrigation technology that could

by a reduction in operating costs and/or increase in crop revenue as a result of targeted, efficient irrigation applications).

51. See T.L. Thompson et al., The Potential Contribution of Subsurface Drip Irrigation to Water-Saving Agriculture in the Western USA, 8 AGRICULTURAL SCIENCES IN CHINA 850, 851 (2009).
54. See T.L. Thompson et al., supra note 51, at 851.
55. See José O. Payero et al., supra note 53.
58. Id. at 46.
59. See T.L. Thompson et al., supra note 51, at 851.
61. See T.L. Thompson et al., supra note 51, at 851; Considerations for Subsurface Drip Irrigation Application in Humid and Sub-humid Areas, supra note 60.
reduce agricultural water consumption in the Southwest. Tailwater is water that “accumulates or runs off the tail end of fields.” A tailwater recovery system is “[a] facility to collect, store, and transport irrigation tailwater for reuse in a farm irrigation distribution system.” Tailwater return allows farmers to reuse runoff irrigation water. By capturing runoff water rather than allowing it to escape, these systems enable farmers to reuse water that would otherwise be wasted. Tailwater recovery systems can also reduce the adverse environmental impacts of agriculture by reducing the amount of water running off from farmlands. However, high installation, maintenance, and operation costs may prevent farmers from adopting tailwater return systems.

iii. Irrigation Scheduling

Regardless of irrigation method, agricultural water users can reduce water consumption by creating irrigation schedules. Unlike subsurface drip irrigation and tailwater return systems, irrigation scheduling does not require installing irrigation infrastructure. Irrigation schedules improve water efficiency by determining the ideal amount of water to use and the ideal time to irrigate to prevent the adverse effects of insufficient soil moisture. Some growers determine soil moisture by feeling the soil, but this is time consuming and can result in a yield loss, even if the grower has a good eye. While irrigation scheduling does not require new infrastructure, infrastructure like soil moisture sensors can create a more precise irrigation schedule and this infrastructure has fewer up-front costs than implementing a new irrigation system; this is not to say, however, that it is without cost. Soil moisture sensors can be expensive, and creating the irrigation schedule is information intensive. Financial assistance, as well as assistance gaining necessary information and expertise, will promote the agricultural use of irrigation schedules.

63. Id.
67. See id. Some soil moisture sensors utilized include neutron probes (approximately $6,400), tensiometers (ranging from $30 to $2000), or Time-Domain Reflectometry (TDR probes), Capacitance (C-Probes), and Frequency-Domain Reflectometers (FDR) (ranging from $5,000 to $10,000). Id.
68. See id. Some soil moisture sensors utilized include neutron probes (approximately $6,400), tensiometers (ranging from $30 to $2000), or Time-Domain Reflectometry (TDR probes), Capacitance (C-Probes), and Frequency-Domain Reflectometers (FDR) (ranging from $5,000 to $10,000). Id.
The federal Farm Bill has played a substantial role in the Southwest’s current water crisis. Subsidies payable under the Farm Bill effectively insures farmers in the Southwest against agricultural losses caused by drought, creating little incentive to alter water-wasting practices. Specifically, crop insurance policies under the Farm Bill indemnify farmers from losses that occur during a crop year, including losses stemming from adverse weather events such as drought. Due to these protections, farmers in drought-stricken California can afford to risk growing water-intensive crops in their arid climate. For example, California still produces 95% of the United States’ broccoli and 99% of its walnuts, despite the water-intensive nature of those crops.

Under the Farm Bill, the federal government is broadly authorized to provide both insurance and reinsurance to agricultural producers for losses caused by drought and other natural disasters. First, the government provides “catastrophic risk protection” to indemnify the farmers when drought causes loss of yield. This protection applies when the producer suffers a 50% loss in yield, and the government provides farmers who suffer that loss with 55% of the commodity’s market price. In 2001, the Bill began providing price protection for farmers, which covers the farmers in the event of a national drop in demand that negatively affects their crop. In exchange for this protection, a farmer must pay a $300 administrative fee per crop. Importantly, the government “may limit catastrophic risk coverage in any county or area, or on any farm, on the basis of the insurance risk concerned.” The farmer may also apply for additional coverage through this program. If no insurance company is willing to accept the risk that the drought represents, the federal government will directly insure the farmer. The government can also limit additional coverage in any county or area on the basis of insurance risk.

The government collects an insurance premium from farmers enrolled in these programs to ensure an expected loss ratio that is no greater than 1.0.

71. 7 U.S.C.A. §1508(a)(1).
72. §1508(b)(1)(A).
73. §1508(b)(2)(A)(ii).
74. See §1508(b)(3)(B)(ii). See generally §9016 (discussing the provisions of price loss protection).
75. §1508(b)(5)(A).
76. §1508(b)(7).
77. §1508(c)(1)(B).
78. Id.
79. §1508(c)(9).
80. §1508(d)(1)(C).
However, the government also covers portions of the catastrophic risk protection and additional protection premiums to ensure broad participation. The government also pays the entire premium for catastrophic risk protection. Depending on the amount of coverage purchased, the federal government may cover an additional 38% to 67% of the premium. The government also provides reinsurance to insurance providers who cover agricultural commodities.

If the Farm Bill did not provide such generous protections against drought risk, it is unlikely that a region with such a categorically unfit climate would house such a large agricultural economy. Indeed, nearly 66% of the country’s crops grow in its most arid regions. To compensate for the lack of naturally occurring moisture, western agricultural producers largely rely on irrigation to support crops, whereas eastern producers depend mostly on precipitation. In 2000, such irrigation withdrawals accounted for the use of approximately 137,000 million gallons of water per day, with 86% of the withdrawals occurring in western states. And, as stated above, flood or “surface” irrigation remains the predominant method of irrigation in the West, even though it is also the most inefficient and most wasteful method. Although California is the nation’s leading user of water-efficient micro-irrigation techniques, the state is also the leading participant in wasteful surface irrigation practices.

Given the Farm Bill’s generous provisions, it is hardly surprising that the scope and costs of these programs are growing quickly. The government now pays approximately 62% of all premiums for participating farmers. These programs enjoy high participation rates that are rapidly increasing. In 1998, the government insured two-thirds of all crops under the Farm Bill. That figure

81. §1508(e)(1).
82. §1508(d)(2)(A).
83. § 1508(e)(2)(B)(i); § 1508(e)(2)(G)(i).
84. §1508(a)(1).
85. See Abrahm Lustgarten & Naveena Sadasivam, Holy Crop, ProPublica (May 27, 2015), https://projects.propublica.org/killing-the-colorado/story/arizona-cotton-drought-crisis. According to Lustgarten and Sadasivam, “No American law has more influence on what, where and when farmers decide to plant. And by extension, no federal policy has a greater ability to directly influence how water resources are consumed in the American West.”
86. See Neuman, supra note 15, at 104.
87. See Noroian, supra note 9, at 182.
88. See Hutson et al., supra note 12, at 20.
89. Id.
90. See Noroian, supra note 9, at 184–5.
93. See USDA RMA, supra note 69.
94. Id.
increased to 80% in 2006.\textsuperscript{95} In 1998, the government’s total liability for American crops was $28 billion.\textsuperscript{96} In 2013, that number swelled to $117 billion.\textsuperscript{97} These indemnities cost taxpayers $10.8 billion in 2011,\textsuperscript{98} while agricultural producers received $1.90 for every $1 of premium paid.\textsuperscript{99} These subsidies are set to cost $94 billion over the next ten years.\textsuperscript{100} Meanwhile, despite the historic drought, in 2012, farming income reached its second highest level in thirty years.\textsuperscript{101} Although President Obama proposed cutting crop insurance subsidies, crop insurance still remains politically popular in the legislature.\textsuperscript{102} One scholar even commented that of all the Farm Bill provisions debated in 2012, crop insurance was “immune from challenge.”\textsuperscript{103}

These generous Farm Bill protections arguably encourage farmers to engage in riskier behavior—an effect known as the moral hazard problem.\textsuperscript{104} This risky behavior is perhaps most evident in the case of cotton—a water-intensive crop—which accounts for nearly one-fifth of all farm acreage in Arizona.\textsuperscript{105} Arizona’s significant cotton farming industry exists largely because insurance subsidies cover almost all risk that farmers otherwise face when growing a water-intensive commodity in an arid region.\textsuperscript{106} The federal government covers the difference in yield that a drought causes, even where water resources are severely limited and farmers might normally lose money.\textsuperscript{107} Moreover, the federal government lends farmers money to cover their losses without expecting full repayment when farmers cannot sell cotton at a profit.\textsuperscript{108} Thus, in situations where market price signals would normally incentivize farmers to stop growing cotton in drought-prone areas or switch to less water-intensive crops, farmers instead continue to grow cotton in the desert.

Concededly, market indicators from the drought have led a small number of farmers to switch crops.\textsuperscript{109} In Kansas, for instance, some farmers are beginning to farm sorghum instead of corn because sorghum requires one-third as

\textsuperscript{95} Gilbert M. Gaul et al., Aid Is a Bumper Crop for Farmers, WASH. POST, (Oct. 15, 2006), http://www.washingtonpost.com/wp-dyn/content/article/2006/10/14/AR2006101400807.html.
\textsuperscript{96} See USDA RMA, supra note 69.
\textsuperscript{97} Janda, supra note 8, at 87.
\textsuperscript{98} Nixon, supra note 92.
\textsuperscript{100} Nixon, supra note 92.
\textsuperscript{101} Id.
\textsuperscript{102} See id.
\textsuperscript{103} See Glauber, supra note 99, at 482.
\textsuperscript{104} See R.L. Heathcote, Drought and the Human Story 179 (2013) (noting that individuals affected by a drought may expose themselves to greater risk because any loss or injury will be compensated by government aid).
\textsuperscript{105} Lustgarten, supra note 85.
\textsuperscript{106} Id.
\textsuperscript{107} Id.
\textsuperscript{108} Id.
much water.10 Although corn can bring larger profits, sorghum serves many of the same uses at a lower environmental cost.11 According to Gebisa Ejeta, who won the World Food Prize in 2009 for his work on sorghum, if farmers had to limit irrigation or pay the true market price for water, sorghum would be the rational crop of choice in several areas of the United States.12 Unfortunately, federal subsidies shield farmers from facing this reality because they do not have to bear the full cost of their decisions, and thus, the subsidies discourage such rational adaptation.13

The Farm Bill has been used in the past to implement conservation-oriented policies.14 In 1985, Congress added the highly erodible land conservation (“sodbuster”) and wetland conservation (“swampbuster”) provisions to the Farm Bill.15 The sodbuster provision withholds government benefits, including disaster payments and loans, for crops produced on natural grasslands in North Dakota and its surrounding states.16 The swampbuster provision withholds government funds from an agricultural producer unless they agree to not convert wetlands for crop production.17 In 2014, Congress decided that federal crop insurance subsidies should also be withheld if a farmer violates the sodbuster and swampbuster provisions.18 Thus, Congress has utilized the Farm Bill to preserve lands the federal government wished to protect.19 Here, if the threat of drought becomes severe enough, Congress could consider similar measures necessary to protect lands in the region from permanent damage.

II. INCORPORATING WATER POLICY CONSIDERATIONS INTO SUBSIDIZED CROP INSURANCE PROGRAMS

Federal crop insurance policies arguably contribute to the severity of the drought and ensuing water crisis by focusing too much on the reimbursement of losses and not enough on water conservation.20 In particular, some programs directly compensate farmers or provide subsidized crop insurance programs to farmers affected by drought.21 Such policies shield agricultural producers from drought-based price signals22 and fail to create optimal incentives to use more water-efficient agricultural technologies.23 Ideally, federal policies should do the opposite, promoting drought preparedness and incentivizing agricultural users

111. See id.
112. Id.
113. Janda, supra note 8, at 99.
115. Id.
117. See Stubb, supra note 114, at 2–3.
118. See id. at 2–3.
119. See Lustgarten, supra note 85.
120. See Neuman, supra note 15, at 105.
121. See id.
122. See Janda, supra note 8, at 98.
123. See id.
to abandon otherwise low-value uses of water.\textsuperscript{124} Adjusting federal agricultural policies to better promote water conservation in the Southwest could be a tremendously valuable first step towards a more water-sustainable agricultural economy.

In 2006, the Congressional Budget Office urged Congress to reconsider the subsidies provided under the Farm Bill, asserting that the subsidies misrepresented price signals and hindered "the transfer of water sources to higher value uses."\textsuperscript{125} When a western farm relies upon government aid to make its operation economically feasible, it impedes innovation and adaptation towards resource conservation.\textsuperscript{126} This is demonstrated by the continued and unsustainable reliance on irrigation withdrawals and the slowness to adopt more efficient technologies or grow alternative crops.\textsuperscript{127} Thus, the federal government's strategy is at odds with the serious threat the drought presents to the southwestern states.\textsuperscript{128}

A state that wanted to employ a market-based solution to agricultural water waste, such as increasing the market price of water, would be thwarted by the safety net that subsidized insurance provides.\textsuperscript{129}

The Southwest relies heavily on federal agricultural subsidies and this subsidy system allows an inordinate amount of water-intensive crops to be grown in the most arid parts of the United States. These policies lead to inefficiencies in the market, frustrating any proposed market-based solution that is designed to promote the agricultural conservation of water. The following section discusses how to amend the Farm Bill to eliminate these inefficiencies, which would result in more water conservation and prepare an agricultural economy for droughts.

Fortunately, Congress does not need to restructure the Farm Bill to address these problems. Under §1508(b)(7) and §1508(c)(9), the government may already limit insurance coverage in specific areas and counties with increased insurance risk.\textsuperscript{130} Furthermore, as seen in the sodbuster and swamplbuster provisions, Congress has previously amended the Farm Bill in response to conservationist movements.\textsuperscript{131} Congress could adopt a similar provision that withdraws benefits from certain water-intensive crops grown in specific counties. Additionally, Congress could shift to a "carrot" rather than "stick" policy that rewards farmers who demonstrate reduced water use or who implement efficient technologies. This policy would place farmers who did not follow such practices at a disadvantage, thereby discouraging wasteful practices.

\textsuperscript{124} See AghaKouchak, supra note 14, at 411.
\textsuperscript{126} See id. at 11-13.
\textsuperscript{127} See id. at 1, 18-19.
\textsuperscript{128} See id. at 11-13.
\textsuperscript{129} See id.
\textsuperscript{130} See §1508(b)(7) (discussing the USDA's ability to limit catastrophic risk coverage based on insurance risk); §1508(c)(9) (discussing the USDA's ability to limit additional coverage based on insurance risk).
A. LIMITING INSURANCE COVERAGE AND TRANSFERRING MORE RISK TO THE FARMERS

Introducing risk into agricultural policy incentivizes farmers to adopt more water-efficient practices. Congress could accomplish this by compelling agricultural producers to pay crop insurance deductibles and by establishing insurance rates that more accurately reflect actual water-related risks. While crop insurance is certainly necessary to shield farmers from extreme weather events out of their control, farms that purportedly experience perpetual disasters arguably should not be allowed to repeatedly cover losses through government protections. This is particularly true for farms experiencing drought in historically arid areas. Congress could pass more water-related risks to farmers in these areas by scaling back insurance benefits as authorized by §1508(b)(7) and §1508(c)(9).

Re-measuring “insurance risk” for drought-stricken areas could take many forms. For farms suffering losses from drought, the government could require that farmers meet minimum water-efficiency standards. Alternatively, the government could require farms meet certain minimum yields over several harvests. This may seem to frustrate the purpose of crop insurance, but it would identify farms that perpetually take from the insurance program and potentially subsist on federal benefits. Furthermore, this gives farms an incentive to maximize yield and productivity, which could promote the adoption of water-preserving technologies. If regulations allocated more water-related risk to these farmers, they would face more accurate cost-benefit decisions and many might be incentivized to grow alternative crops more suitable to the environment, to relocate, or to close their operations entirely. The government could ease this process by offering subsidies or grant programs that encourage crop switching, such as offering payments for newer irrigation technology to farmers that switch from corn to sorghum, or from cotton to cauliflower.

Of course, there would be heavy opposition to any such changes. For instance, orchard farmers could particularly suffer. Perennial crop producers such as orchard farmers are particularly reluctant to relocate because their crops demand extraordinary amounts of time and money. Growers of these crops could need a special carve-out from any efficiency or yield requirement to avoid

132. See Janda, supra note 8, at 101.
133. See id. at 102.
134. See Fahrenkamp-Uppenbrink, supra note 29 (discussing how the drought may be the worst in the past millennium).
135. See §1508(b)(7) (discussing the USDA’s ability to limit catastrophic risk coverage based on insurance risk); §1508(c)(9) (discussing the USDA’s ability to limit additional coverage based on insurance risk).
136. See §1508(b)(1)(A). The government could also consider the implementation of irrigation practices discussed in Part II to be valid risk mitigation.
137. The major purpose of crop insurance is to protect the farmers when crop yield is down.
139. See id.
financial ruin. On the other hand, the eventual closure of many walnut orchards may ultimately be a cost-efficient adjustment as California’s water supplies become ever more precious. The closing of that industry in an arid state could create incentives for the planting of new walnut orchards in more sensible locations.

B. REDUCING BENEFITS FOR WATER-INTENSIVE CROPS GROWN IN ARID REGIONS

In addition to transferring more insurance risk to farmers, the government could take the approach seen in the sodbuster and swampbuster provisions of the Farm Bill and create a “droughtbuster” program. A droughtbuster would establish areas where certain crops cannot be grown if the farmer wishes to receive federal benefits. This may be the strongest measure to increase drought resilience because it would essentially “relocate” water-intensive crops to other parts of the country that can support them. At the same time, this is the most controversial method, as the western states with agricultural economies would likely accuse the federal government of favoring the economies of eastern and midwestern states. Unlike the states affected by the sodbuster and swampbuster provisions, California, Arizona, and Texas may not want to “conserve” their deserts, and voters in southwestern states may conclude that they receive no benefit from the droughtbuster. However, the “buster” provisions are aimed at conserving natural resources, which undoubtedly includes water. Thus, while western state politicians may hesitate to support the change, they may internally rejoice; these politicians do not have to make the politically risky move of “injuring” their own agricultural economy to save their natural resources. With the addition of a droughtbuster, states can attack drought without the additional problems associated with subsidized farms.

The droughtbuster approach may be unacceptable to many because it involves the government making market decisions with respect to which crops can be grown in particular locations. The government is arguably not in the best position to consider all of the market factors of such decisions. Instead, these choices may be better left to individuals in the agricultural sector to decide where and when to grow their crops. However, the droughtbuster would actually reduce market inefficiency. The current market cannot be called “free” because some farms are kept alive by subsidy instead of market performance. A droughtbuster policy would not make it a criminal offense for a farmer to

140. See id. at 149.
141. See id.
142. See id.
143. See supra text accompanying notes 114–19.
144. See Stoa, supra note 70, at 436.
145. See Neuman, supra note 15, at 106 (“Although it is sacrilege to ask, would we be better off, as a nation, investing in redeveloping the eastern and midwestern agricultural industry rather than continuing to subsidize growing cotton and cows in the desert?”)
146. See Stubbs, supra note 114, at 2.
grow cotton in a drought area—it would merely remove the federal safety nets previously protecting such activity.

C. CREATING INCENTIVES FOR WATER CONSERVATION

A droughtbuster program would likely invoke strong political opposition from agricultural stakeholders. One potential means of mitigating that opposition could be to structure such programs as providing “carrots” rather than administering “sticks.” Specifically, officials could create long-term financial “incentives for adaptation,” such as rebates or tax credits for investments in water-saving technologies. Such a policy approach may be more politically palatable to drought-stricken agricultural states—it could keep agricultural activities intact and reduce water consumption, while the federal government foots most of the bill.

Among other things, the government could establish grant or loan programs that promote the best practices of irrigation capable of improving drought-readiness. For example, when drought struck California in 1991, some farmers reduced water consumption by 10% without sacrificing yield just by consulting irrigation experts on irrigation scheduling. The farmers achieved these results despite relying on surface irrigation, even when a growing number of other farmers in the state moved to more efficient irrigation methods. Thus, if the government was able to make the costs of adopting such technology lower for the farmers, the state could appreciate a decrease in water consumption.

The subsidized crop insurance program complicates these incentives. Despite the drought and falling yields, the agricultural industry is still making record profits. If southwestern farmers accept the grant program, it may improve their yields but interfere with their ability to collect federal insurance. The rational farmer would be left with a dilemma: increase the efficiency of his farm and perhaps fail to recover some of the benefits afforded to him by the Farm Bill, or reject the grant program, recognize a reduction in yield, and recover insurance.

The federal government could conceivably create financial “lures” for farmers to grow water-intensive crops in other areas of the country. However, without a change to the current crop insurance program, such an approach could send mixed messages to farmers. On one hand, the government would be subsidizing price-protection policies to keep the farms afloat in the Southwest. On the other hand, it would be fostering competition by supporting those same

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148. Janda, supra note 8, at 106 (A “carrot and stick” program incentivizes one behavior (“carrot”) and discourages other behaviors (“stick”).

149. See id. at 101.


151. See id. at 22.

152. See id.

153. See Nixon, supra note 92 (“Farmers’ net income for 2012 is expected to be $114 billion, down 39% from 2011 but still the second highest in 30 years.”)

154. See id. Loss of yield triggers the insurance payouts.
crops in other parts of the country. The result might well be an increase in supply that could trigger price-protctions for the Southwest. In that scenario, the government would effectively pay to both save and kill southwestern farms.

D. INCORPORATING VIRTUAL WATER INTO WATER-RELATED GOVERNMENT PROGRAMS

Water is necessary to create all agricultural and non-agricultural commodities. The water embedded in the production of these commodities is known as “virtual water.” Water is embedded in everything from your jeans to your lunch. Shipping water-intensive products into a different water basin, county, state, or even country necessarily ships water outside of the area. It follows that the trading of water-intensive crops is also the trading of this virtual water.

Agricultural areas can lessen the stress on their water supplies by recognizing that all products have water value, incorporating virtual water into their trade practices, and importing more water-intensive products. For instance, an almond requires one point one gallons of water to reach maturity. In 2014, this statistic sparked a trend known as “almond shaming” and prompted people to make comparisons of crops based on the water necessary to produce them. While some of these arguments fail to incorporate market value, area suitability, and demand for crops, they do touch on one key point: water is required in all agriculture, and growing crops in certain areas requires value-based decisions.

The USDA could determine that arid areas that operate as net exporters of water are insurance risks. The USDA could then limit the subsidies in areas that ship virtual water through water-intensive crops without offsetting the exported virtual water through imports. This would require farmers to internalize the costs of shipping virtual water outside of the arid region. This command and control model might prompt a coalition effort among farmers and local and state governments to consider the area’s trading practices’ net water impact. However, this solution may not be reasonably tied to an individual farmer’s practices. If the individual farmer’s actions do not directly affect the outcome, there may be no proper incentive to utilize efficient irrigation practices.

155. See J.A. (Tony) Allan, Virtual Water - the Water, Food, and Trade Nexus Useful Concept or Misleading Metaphor?, 28 WATERR INT’L 4, 5 (2003) (“Virtual water is the water needed to produce agricultural commodities. The concept could be expanded to include the water needed to produce non-agricultural commodities.”).
157. See id at 4–5.
Alternatively, the USDA could use a cooperative federalism model to incorporate virtual water into its insurance program. Under this option, the agency would create a virtual water import and export standard for each state. States would then have the opportunity to create their own plans to implement these standards or adopt a federal implementation plan created by the agency. This solution would require an information-intensive study of states’ current agricultural and trade practices.

A cooperative federalism model allows the USDA to consider which states are in the best position to import or export a greater amount of water-intensive products. Individual states would still retain control as to how to meet those needs. This model protects states’ interests in water conservation while promoting trade between states. Absent federal control, arid states could create more comprehensive trade plans that incorporate virtual water and encourage the importation of water-intensive products. If a state becomes a net water importer, it could have more freedom to choose which crops it produces.

In summary, there is a wide array of potential policy strategies for better incentivizing drought preparedness in agriculture. The best approaches would likely involve some combination of minimum water efficiency standards, changes to insurance benefits, and grant programs to incentivize farmers’ investments in water conservation technologies.

III. DRIVING FARMERS’ ADOPTION OF WATER-EFFICIENT IRRIGATION PRACTICES

Despite the severity of the water scarcity problem in the Southwest, many of the most efficient irrigation technologies that already exist are not widely implemented. Determining the appropriate water-efficient agricultural irrigation practice requires a climate, crop, and land-specific analysis. As discussed in Part I(B)(4), some possible techniques for irrigation in the arid Southwest include subsurface drip irrigation, tailwater return systems, and irrigation scheduling. Creating incentives to adopt water reducing irrigation practices through government programs and private partnerships can help to solve water scarcity in the Southwest.

Obviously, if a farmer can use a technique to produce the same yield while using less water, that technique should be utilized. However, these techniques are not widely implemented for two reasons. First, the costs may be prohibitively expensive. Second, adopting water-saving techniques may cause the user to lose water rights under prior appropriation. Creating solutions to these two issues will promote the adoption of water-efficient irrigation practices.

A. GOVERNMENT FINANCIAL ASSISTANCE

As emphasized in Part II, the USDA could help agricultural water users overcome the financial burden of implementing water reducing irrigation practices by providing federal loans or grants. Doing so would stimulate the adoption of these expensive technologies. The Southwest plays an important role in
the United States’ food production, and the federal government might be interested in subsidizing water-reducing technologies to ensure agriculture continues to thrive in the region and prevent increased dependency on foreign crops.

Even without federal intervention, states themselves can implement loan or grant programs to help finance efficiency technologies. The California Department of Water Resources currently offers financial assistance for various water projects. As of January 27, 2016, these now include Agricultural Water Use Efficiency Grants. These grants seek to fund projects that would improve water efficiency and water quality, reduce energy requirements, and provide environmental benefits. Examples of eligible projects include “water use efficiency planning, research and development, feasibility studies, pilot, or demonstration projects,” “water use efficiency training, education, or public education programs,” and “water use efficiency technical assistance programs.” The current California model does not provide direct assistance to private agricultural water users, as the grants are only available to “local agencies, joint powers authorities, public water/irrigation districts, ... Indian tribes, nonprofit organizations, [and] other political subdivisions of the state involved with water management.” However, it is conceivable that a state could provide direct assistance to private users for the benefit of the public. In exchange for financial assistance in the form of a grant or loan, private users could turn over a portion of their prior appropriation water rights to the state, divert less riparian surface water in California, or pump less groundwater. Leaving more water in the stream helps instream uses, like recreational and environmental uses, and helps relieve evaporation issues that affect other beneficial uses.

B. PRIVATE PARTNERSHIPS

Efficient irrigation technologies can also be promoted through private partnerships. Water rights owners and parties seeking water can create private partnerships through short-term leases. Under a leasing program, agricultural water users retain their water rights instead of selling them. A lease may involve traditional monetary compensation for the water rights holder. The financial

160. Joe Satran, This Is Where America Gets Almost All Its Winter Lettuce, HUFFPOST TASTE, http://www.huffingtonpost.com/2015/03/04/yuma-lettuce_n_6796398.html. (Almost 90% of all the winter leafy vegetables in the United States are produced in the Yuma, Arizona area); see Julie Lurie & Alex Park, supra note 158 (California produces 95% of broccoli, 92% of strawberries, 91% of grapes, and 90% of tomatoes in the United States.)

161. See All Funding Topics, CAL. DEPT. OF WATER RESOURCES (Nov. 17, 2015), http://www.water.ca.gov/nav/index.cfm?id=103.


163. Id.


165. Water Use Efficiency Grants and Loans, supra note 162.

166. Jeannine Jones, California Perspectives - Water Transfers, DEPARTMENT OF WATER RESOURCES (July 2011) (Most states, including California, currently allow for short-term transfers; but see Fehlmann, supra note 44, at 17 (Arizona, an important agricultural southwestern state, does not participate.).
incentive may encourage agricultural users to engage in more efficient irrigation practices.

Alternatively, under the right set of conditions and rules, farmers could conceivably take a more market-oriented approach. For instance, a farmer could purchase and maintain water-efficient irrigation technologies and then lease the water conserved through those investments to someone else. Under that sort of arrangement, parties are incentivized to implement the best water saving technology, up to the point where it is no longer economically cost-justified, while water rights holders are able to maintain their rights. Such arrangements could do much to promote efficient water use practices while still preserving western agriculture.

Unfortunately, there are numerous barriers to forming these sorts of private arrangements. Proposals for severance and transfer, change in diversion point, or change in use can face high transaction costs such as navigating various state water rights regimes, separating surface water from groundwater, and defeating notice and comment processes involved with changes in use or diversion. Uncertainty over water entitlements only adds an additional layer of cost and difficulty to making these arrangements.¹⁶⁷

All too often, the transaction costs associated with creating these private partnerships can become too high to allow for efficient outcomes.¹⁶⁸ It is difficult to match private water rights owners with private parties seeking water. Fortunately, there are means of addressing this problem. Recently, the National Science Foundation funded research that led to the development of Mammoth Trading, a company that seeks to match water resource buyers and sellers.¹⁶⁹ Mammoth also helps users navigate regulations and reach a fair price.²⁰ Although Mammoth currently only focuses on sales of groundwater in Nebraska,¹⁷¹ it is conceivable that a similar system could close the gap between buyers and sellers of western water leases. Determining the efficient irrigation technology to implement also requires a high level of information and expertise. Additionally, agricultural users may not have access to water lawyers to represent their interests in the partnership. Like many legal situations, there is a possibility that the less sophisticated party will be disadvantaged. Closely related, small water

¹⁶⁷. See Gila River and Little Colorado River General Stream Adjudications, ARIZONA DEP’T OF WATER RESOURCES (Mar. 27, 2014), http://www.azwater.gov/AzDWR/SurfaceWater/Adjudications/GilaRiverandLittleColoradoRiverGeneralStreamAdjudications.htm, for an example of solution to this problem through Arizona’s current process of two general stream adjudications, which seek to involve all water rights holders within a basin and adjudicate their relative priority, use, diversion points, and flow to eliminate the uncertainty and risk that hinders the water market.

¹⁶⁸. See Guido Calabresi, Transaction Costs, Resource Allocation and Liability Rules—A Comment, 11 J.L. & Econ. 67, 68 (1968) (According to Guido Calabresi’s interpretation of the Coase theorem, “if one assumes rationality, no transaction costs, and no legal impediments to bargaining, all misallocations of resources would be fully cured in the market by bargains”; therefore where there are no transaction costs, the market will generate efficient resource allocations, regardless of how property rights are divided) (emphasis in original).


¹⁷⁰. See id.

¹⁷¹. See id.
rights owners in agricultural communities may distrust private businesses. An imbalance of information may prevent agricultural water users from potentially beneficial partnerships.

Most states have bifurcated water regimes, distinguishing between surface water and groundwater. In Arizona, groundwater is treated as a separate entity from surface water.\(^{172}\) While surface water may be bought and sold independent of the land, groundwater is typically appurtenant to the land.\(^{173}\) However, the distinction between surface water and groundwater is unclear,\(^{174}\) further complicating possible water transfers on a river segment. However, a bifurcated water system does not pose as many complications to parties wishing to use groundwater on the original tract of land or to parties who have their surface water delivered via canal.

If the party seeking to obtain surface water rights does not wish to use them for a beneficial use, the lease could fail. Surface water in Arizona,\(^{175}\) Colorado,\(^{176}\) New Mexico,\(^{177}\) Nevada,\(^{178}\) and Utah\(^{179}\) is subject to prior appropriation and limited to beneficial uses. Surface water uses in California must be "reasonable

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173. & \text{See Fehlmann, supra note 44, at 28.}
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174. & \text{See generally In re the Gen. Adjudication of All Rights to Use Water in the Gila River Sys. and Source, 857 P.2d 1236, 1238-39 (1993) ("Gila II") (Noting that a bifurcated legal system does not mirror the intermingling between groundwater and surface water and that subflow, while underground, is still surface water); see also In re the Gen. Adjudication of All Rights to Use Water in Gila River System and Source, 344 P.3d 1069, 1083 (2000) ("Gila IV").}
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175. & \text{Surface Water Rights, ARIZ. DEP'T OF WATER RESOURCES (Mar. 27, 2014). http://www.azwater.gov/AzDWR/SurfaceWater/SurfaceWaterRights/SurfaceWater_FAQ.htm. (In Arizona, beneficial use includes domestic or municipal purposes, irrigation, stockwatering, hydroelectric power, recreation, wildlife including fish, nonrecoverable water storage, and mining).}
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176. & \text{Water Rights Dictionary, COLO. DIVISION OF WATER RESOURCES, DEP'T OF NAT. RESOURCES, http://water.state.co.us/SurfaceWater/SWRights/Pages/WaterRightsTerminology.aspx. ("Beneficial use is the use of a reasonable amount of water necessary to accomplish the purpose of the appropriation, without waste. Some common types of beneficial use are: irrigation, municipal, wildlife, recreation, mining, household use."); see also, Prior Appropriation Law, COLO. DIVISION OF WATER RESOURCES, DEP'T OF NAT. RESOURCES, http://water.state.co.us/SurfaceWater/SWRights/Pages/PriorApprop.aspx.}
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177. & \text{N.M. CONST, art. XVI, § 3. ("Beneficial use shall be the basis, the measure and the limit of the right to the use of water" in the state of New Mexico.); Glossary of Water Terms, N.M. OFFICE OF THE STATE ENGINEER, INTERSTATE STREAM COMMISSION, http://www.ose.state.nm.us/WR/glossary.php. (Beneficial use in New Mexico is "the use of water by man for any purpose which benefits are derived, such as domestic, municipal, irrigation, livestock, industrial, power development, and recreation.").}
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179. & \text{Glossary of Water Words, UTAH DIVISION OF WATER RIGHTS (May 28, 2015), http://www.waterrights.utah.gov/wrinfo/glossary.asp. (Examples of beneficial uses in Utah include, but are not limited to, irrigation, stock watering, domestic, commercial, industrial, and municipal uses.)}
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and beneficial" and are governed by a blend of riparian and prior appropriation regimes. The party’s intended use must meet the relevant state’s definition of a beneficial use.

The party seeking water rights and the current water rights holder will also need to overcome objections from other interested parties. Water rights applications are subject to a public notice and comment period in Arizona, California, Colorado, New Mexico, Nevada, and Utah. This process can be lengthy and expensive. According to the Colorado Department of Natural Resources’ Division of Water Resources, the process can take “anywhere from 4 months to 2 years and beyond, depending on the complexity of the case.” Additionally, costs for necessary experts are high, with water lawyers ranging from $150 to upwards of $300 an hour and engineering ranging from $100 to $200 an hour. The process to defeat protests can be a substantial barrier to all severance and transfer, change in diversion point, or change in use applications, including applications necessary for short-term leases. If states adopt an expedited review system in exchange for the water rights owner trading through a state market and foregoing a portion of their water rights, overcoming a notice and comment process will be a less significant barrier.

180. The Water Rights Process, STATE WATER RESOURCES CONTROL BOARD, http://www.waterboards.ca.gov/waterrights/board_info/water_rights_process.shtml. (“These “beneficial uses” have commonly included municipal and industrial uses, irrigation, hydroelectric generation, and livestock watering. More recently, the concept has been broadened to include recreational use, fish and wildlife protection, and enhancement and aesthetic enjoyment.”)

181. See Glossary of Water Terms, supra note 177; Glossary of Water Words, supra note 179; Surface Water Rights, supra note 175; The Water Rights Process, supra note 180; Water Resources, supra note 178; Water Rights Dictionary, supra note 176.

182. Lin Fehlmann, supra note 44, at 21, 25-27, 35. A surface water rights owner must go through a permitting process to change their type of use or diversion point in Arizona. A transfer of water rights from an agricultural user will likely require a change in diversion point and/or use. If the new owner wishes to change the kind of use or the diversion point, they must file an application with the Director of the Department of Water Resources and will be subject to a public notice, comment, and objection process. The new user must overcome objections from stakeholders including junior appropriators. Changes must not impact existing and vested rights. In Arizona, it is not difficult to challenge a change in diversion or severance and transfer by proving the change either conflicts with vested rights, is a menace to public safety, and/or is against the interests and welfare of the public.

183. See generally The Water Rights Process, supra note 180 (explaining the permitting process that includes a public notice period for states under the prior appropriation system, including California).


188. Obtaining a Water Right, supra note 184.

189. See id.

Lease proposals that involve moving water outside of the basin also raise many political questions. Inter-basin transfers are politically unpopular, but have been happening for decades in California. These are especially controversial when transfers involve mining groundwater and placing the aquifer at risk of depletion.

Despite these barriers, short-term leases can be a solution to promoting more efficient agricultural water use. Being able to lease water rights creates an incentive for farmers to utilize their water efficiently so they may profit from the excess water. Short-term leases in exchange for water-reducing irrigation infrastructure will also quickly stimulate the adoption of this technology. Creative exchanges allow for the water to be used efficiently and the “saved water” to be put to another beneficial use.

In conclusion, promoting the adoption of water-reducing irrigation practices can help reduce the water scarcity problem in the Southwest by reducing the water required for current agricultural practices. Technologies that increase water-efficiency already exist, but are not being adopted because of the high financial and transaction costs inherent in prior appropriation regimes. Financial assistance and the ability to sever water rights in exchange for financial compensation or direct irrigation infrastructure will promote the use of these practices.

**CONCLUSION**

Current government policies are not doing enough to address persistent water scarcity problems in the American Southwest. Although records show that droughts have affected the region for centuries, it is apparent that droughts are returning with more frequency and severity. Human activities are also exacerbating the water scarcity problem, causing the consequences of these droughts to be worse than ever. Over the years, advancements in technology have created an expectation of ease and comfort in the desert where residents enjoy green lawns, take long showers, and consume water-intensive foods grown in water-scarce areas. It is hardly surprising that many residents of the region do not want to sacrifice these luxuries in spite of their water-related consequences.

Although they garner far less attention than suburbanites, the greatest contributors to water scarcity problems in the Southwest are agricultural water users—farmers and ranchers who have insufficient incentives to conserve the scarce water resources appropriated to them. Agriculture plays an invaluable role in the American economy, bringing food to our dinner tables every day. However, the excessively loose water use practices associated with agriculture


192. See id. (In this proposal, two ranchers in Merced County would pump seven billion gallons of their groundwater and send it to farmers in Del Puerto Water District through canals); see generally Richard Cowen, Chapter Eighteen: Mining Water, U. OF CALIFORNIA, DAVIS, http://mygeologypage.ucdavis.edu/cowen/"gel115/115CH18miningwater.html. Information about the harmful and permanent effects of mining aquifers.
in the Southwest are imposing ever greater costs on urban and suburban populations. Accordingly, the regulatory structure that governs agricultural water use needs to change, and there is not a single “fix-all” solution.

All too often, water management laws shield producers and consumers from paying the real cost of water. Many farms are subsidized so generously that they are able to profitably grow water-intensive crops, such as cotton and tree nuts, in the desert without being deterred by the environmental consequences of that activity. Without regulatory and price signals that truly reflect the value of water, agricultural users are unlikely to optimally conserve this precious resource.

In a country that is experiencing population growth and a rise in demand for agricultural products, the Farm Bill must be amended to reduce federal subsidies to farms that grow water-intensive crops in arid regions and increase such subsidies in other parts of the country. Federal and state governments should also promote the adoption of water-reducing irrigation techniques by giving farmers financial assistance to implement new infrastructure and allow “saved water” to be put towards other beneficial uses. These changes and others described in this Article could help create a more efficient water market that is reflective of the ongoing drought and better protects the nation from its consequences. The costs of inaction or delay in this area could be catastrophic and irreparable, so much is at stake. It is time for water use practices on the farm to catch up with those in our homes and backyards.

193. See Noroian, supra note 9, at 183.
194. See id.
195. See id.