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Monterey County Groundwater Policy Analysis

I. INTRODUCTION

The state of California is widely recognized as a major producer of agricultural goods due to its favorable soil and climate. Unfortunately the state is enduring its fourth year of severe drought, and the agriculture industry has had difficulty finding surface water sources to maintain production. Although many farmers have started turning to groundwater for irrigation, farmers in Monterey County have historically relied on groundwater for their crops, namely the Salinas River Groundwater Basin, because it is the primary source of water in the area.[1] The geology of the basin makes it resistant to collapsing or subsiding when over drafted, but its location next to the Pacific Ocean makes it susceptible to seawater intrusion. This year, Monterey County farmers have been productive despite the drought because they have been able to extract enough water from the basin. However, the Monterey County Water Resources Agency (MCWRA) has assessed that extraction in some areas of the basin are currently unsustainable, meaning that its future use may be compromised. The major consumers—and therefore, stakeholders—of the basin are agricultural businesses, urban consumers, and environmentalists. In response to the drought, conserved water in urban areas is not shared with the environment.[2] This policy analysis will only explore the human use of groundwater, so environmentalists will be excluded from the

[1] Land Watch Monterey County. 2008. "Summary of Water Supply Projects for Monterey County." *Land Watch Monterey County*. October 21. Accessed December 01, 2015. http://www.landwatch.org/pages/issuesactions/water/102108watersummary.html.

[2] Clary, Jennifer, interview by Michelle dela Cruz. 2015. *Clean Water Action Program Associate* (November 13).

stakeholder analysis. As groundwater levels diminish, the policies around its extraction and distribution becomes more controversial. Considering the potential effectiveness of the new Sustainable Groundwater Management Act, what are some ways to reduce extraction of the Salinas River Groundwater Basin to improve water security in Monterey County?

II. BACKGROUND

Geology

Aquifers are geologic formations of permeable rock layers that occur beneath the Earth's surface where water can accumulate and be stored as groundwater. The level of groundwater that occurs near the top of the aquifer closest to the surface is called the water table and it indicates the amount of stored groundwater that is accessible through wells. Aquifers have a natural cycle of recharge and discharge where the water table rises and falls as water enters and exits the aquifer. Natural recharge—known as infiltration—is a slow and gradual process where gravity draws surface water into soil and permeable rock layers until it reaches impermeable rock and accumulates. Discharge can occur naturally when an overflowing water table causes groundwater to flow out in a spring, or artificially through man-made wells.[3] Discharge for aquifers near the coast, such as the Salinas River Groundwater Basin, can be problematic when too much groundwater is extracted. Seawater can seep into the basin and render subsurface freshwater unusable by increasing its salinity, which is known as seawater intrusion.[4] Another problem with over-extraction is land subsidence. Groundwater is stored in pore spaces between unconsolidated rock layers and usually this pore space is conserved as long as it is occupied with water because

[3] McGinley, Mark. 2013. "Aquifer." *The Encyclopedia of Earth.* March 28. Accessed October 6, 2015. http://www.eoearth.org/view/article/150158/.

[4] U.S. Geological Survey. 2013. *Saltwater Intrusion.* January 03. Accessed November 29, 2015. http://water.usgs.gov/ogw/gwrp/saltwater/salt.html.

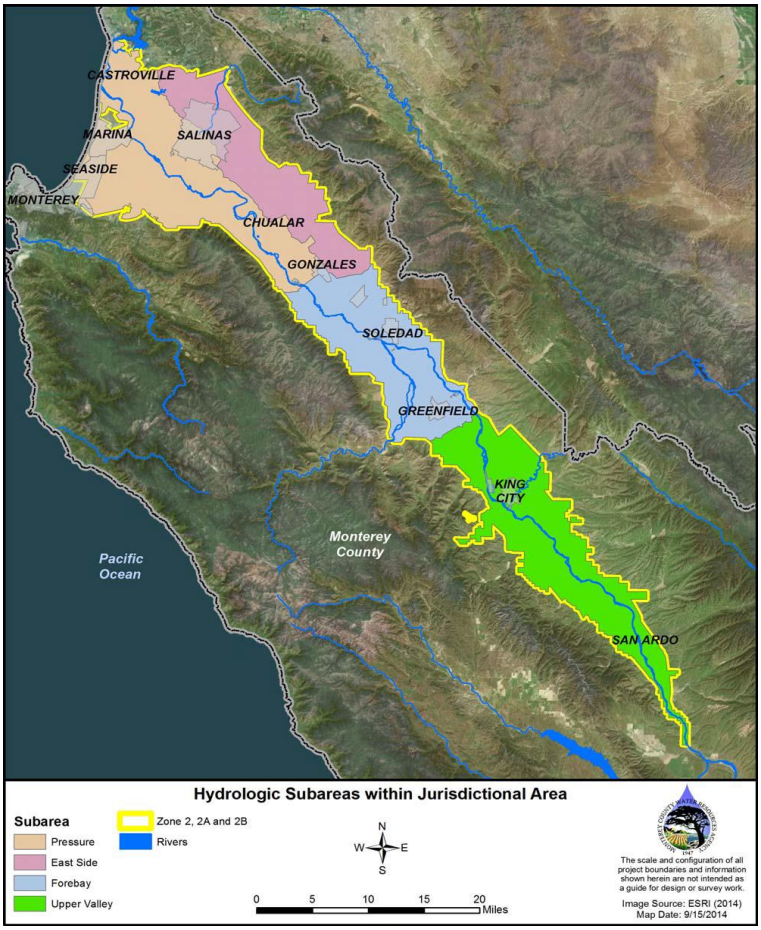

Figure 1. Agency zones and hydrologic subareas of the Salinas Valley Groundwater Basin (excluding the Arroyo Seco subarea). MCWRA 2013 Groundwater Extraction Summary Report.

water can't be compressed. So when more water is extracted than recharged, the rocks around empty pore spaces have the opportunity to compress, allowing land to collapse and subside. Generally volumes of groundwater are measured in acre-feet, which is the amount of water that occupies one square acre by one foot. One acre-foot is equivalent to 325,851 gallons of water.

The Salinas River Groundwater Basin is part of the Salinas Valley aquifer system that extends from San Luis Obispo through the Salinas Valley and flows out into the Monterey Bay. It is the largest basin in Central California and the main source of water for Monterey County.[5] The basin is comprised of five subareas: Pressure, East Side, Forebay, Arroyo Seco, and Upper Valley, as shown in Figure 1. The Pressure subarea is further divided into three aquifers: Pressure 180-foot, 400-foot, and 900-foot which is also known as the Pressure Deep aquifer. Due to the growing population density and agriculture industry, the Pressure and East Side subareas experience heavy groundwater extraction.

[5] Water Education Foundation. n.d. *Monterey Water Sources*. Accessed November 29, 2015. http://www.watereducation.org/community/monterey.

History

Groundwater extraction from the basin began in the late 1800s and became common practice in the early 1900s when sugar beet crops were popular in the valley. Seawater intrusion in the area was first observed around the 1930s. Consequently, Lake Nacimiento and Lake San Antonio were built in 1957 and 1965, respectively, to recharge the basin and prevent further intrusion. After groundwater use in the Salinas Valley peaked in the early 1970s, the basin was considered for state adjudication 1977 by the State Water Resources Control Board (SWRCB). Adjudication would give the state the power to manage the basin, however the control board did not follow through with it.[6] Subsequently, California adopted the Groundwater Management Act in 1992—also known as Assembly Bill 3030—which provided a systematic approach for local agencies to create their own groundwater management plans. By 1995, the Monterey County Water Resources Agency issued an ordinance for agricultural water conservation. Three years later, Monterey County implemented a 75 million dollar waste water treatment project to provide a supplemental source of irrigation water for coastal farms. Then in 2002, the Groundwater Management Act was amended by Senate Bill

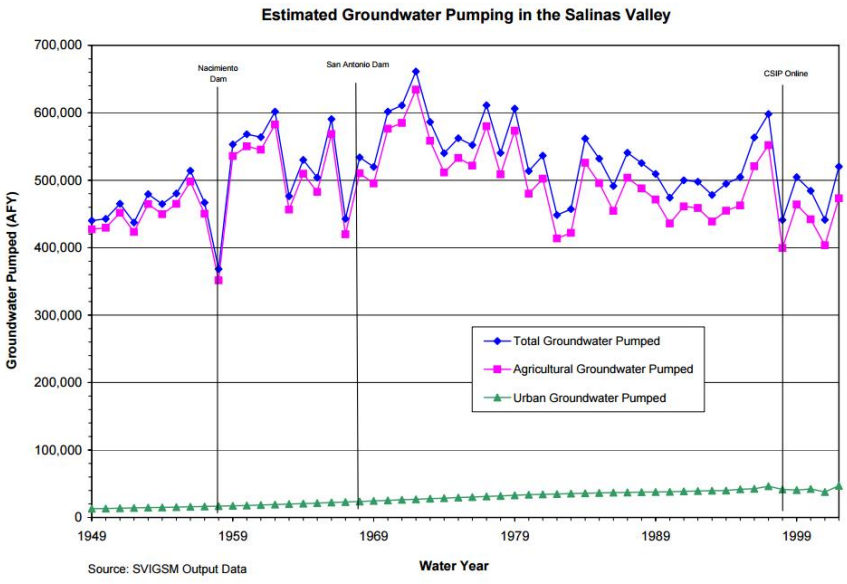

Figure 2. Total groundwater extraction comparing agricultural and urban use. Monterey County Groundwater Management Plan.

[6] Anderson, Burton. 2000. *America's Salad Bowl: An Agricultural History of the Salinas Valley*. Salinas, CA: Monterey County Historical Society.

1938, requiring local agencies to meet specific criteria in their groundwater management plans in order to qualify for state assistance in funding water projects. The Sustainable Groundwater Management Act in 2014 marks the most recent groundwater legislation to pass in California. The new act builds on its precedent act from 1992, but requires the establishment of a local agency to develop and implement a sustainable groundwater management plan, and allows the state government to intervene if agencies are unwilling or unable to meet these sustainability requirements.[7]

Current Situation

Sustainable management legislation is passed with the intent of serving the public but has inevitably become controversial for agricultural communities in California. Drought conditions contribute to the controversy in Monterey County by compelling a prioritization between water conservation and the economic integrity of the agriculture industry. The fact that agriculture uses about 90% of extracted groundwater (as represented in Table 1 and Figure 2) has become a point of contention regarding water conservation. The MCWRA has summarized several important points in their State of the Salinas River Groundwater Basin report from 2014: large reductions in water storage in the Pressure and East Side subareas indicate unsustainable extraction; and drought conditions will make extraction of the basin necessary, but detrimental; but water projects involving reduced pumping have

Subarea	Agricultural Pumping (acre-feet)	Urban Pumping (acre-feet)	Total Pumping (acre-feet)
Pressure	98,141	19,101	117,242
East Side	82,895	14,727	97,622
Forebay	140,574	7,893	148,467
Upper Valley	141,263	3,611	144,874
Total	462,873	45,332	508,205
Percent of Total	91.1%	8.9%	100%

Table 1. Total extraction data by hydrologic subarea and type of use. MCWRA 2013 Groundwater Extraction Summary Report.

[7] California Department of Water Resources. 2015. *Groundwater Information Center*. October 01. Accessed October 6, 2015. http://www.water.ca.gov/groundwater/groundwater_management/legislation.cfm.

shown improvements in aquifer storage, indicating an effective action toward preserving the basin.[8]

General Approaches to Reduce Groundwater Extraction

Institution and technology are two general approaches to reducing groundwater extraction. Institutional approaches involve changing how water is managed through rules and regulations, while technological approaches involve the development of water projects and structures to provide alternative sources to groundwater.[9] Although an integrative approach could synergistically be more effective than either approach alone, I will focus only on institutional approaches for an in-depth policy analysis. The two mutually exclusive, institutional policy options are increasing agricultural water regulations and maintaining existing agricultural water regulations; which may be implemented by the California state government or Monterey County Water Resources Agency.

III. STAKEHOLDER PERSPECTIVES

The Agriculture Industry

The agriculture industry in Monterey County is a major stakeholder in the management of the Salinas River Groundwater Basin because they are the largest consumer of its extracted water. The Monterey County Farm Bureau is a major advocate for agricultural water security that can be considered a representative stakeholder for the agriculture industry. Agricultural businesses generally argue that their extraction of groundwater is justified because they provide significant economic and food security contributions to the county. As such, their central value is

[8] Monterey County Water Resources Agency. 2014. *State of the Salinas River Groundwater Basin Report.* Executive Summary, Monterey County.

[9] Giordano, Mark. "Global Groundwater? Issues and Solutions." *Annual Review of Environment and Resources 34* (2009): 153–178. Accessed September 22, 2015. doi:10.1146/annurev.environ.030308.100251

having water security to support their other values in food security, and ultimately, economic sustainability. Policies that impose on their groundwater extraction threaten the water security they need to keep their business running and maintain economic sustainability. The Monterey County Agricultural Commissioner stated the fact that agriculture provides roughly $1.8 billion a year to the local economy in a recent economic contribution report.[10] This central fact strongly supports the agriculture's argument about their economic importance which makes it relevant to the issue of regulating agricultural business practices. However, the objectivity of research and calculations that produced this economic contribution number remains questionable. Even though the Agricultural Commissioner could be considered unbiased for operating under local government, reported monetary figures such as economic contribution could be influenced by political pressure and reputation risks, and it is not clear how the figure of $1.8 billion was calculated. The Agricultural Commissioner's Report only recently began including total economic contributions as of 2012, meaning there has been little opportunity to evaluate the accuracy of the calculation methods used. However, since this number corresponds to recent extraction rates, farmers make the basic empirical assumption that restricted groundwater means less crop production and fewer profit to contribute to the county.

KQED—assumed to be unbiased as a public broadcasting service in Northern California—has also reported the fact that unplanted land has resulted in a $2 billion loss for California farmers.[11] However, the agricultural industry's central empirical assumption that reducing or limiting their groundwater is detrimental for their business also holds for environmental reasons. As promoters of food security over profit, the Food and Agriculture

[10] Lauritzen, Eric. 2015. *Economic Contributions of Monterey County Agriculture.* Monterey Agricultural Commissioner, Monterey County.

[11] KQED. 2015. *Does California's Agriculture Industry Need More Water Restrictions Due to the Drought?* April 29.

Organization of the United Nations (FAO) explains on their website what many farmers know for fact: not planting crops can harm the soil by removing the cover and stabilizing root systems that would otherwise prevent soils from eroding and becoming unusable.[12] In this sense, restricting groundwater extraction to the point where crops could not be planted and watered could threaten farmers' ability to maintain food security for the population in general. For these reasons, the agriculture industry in Monterey County feels their groundwater extraction is justified, so they are against increased agricultural restrictions and regulations on groundwater pumping.

Urban Consumers

Urban consumers include county residents and commercial businesses who support increasing water restriction and regulation in the agriculture industry. The Planning and Conservation League based in Sacramento, California is an environmental organization that argues for water conservation wherever possible, supporting urban consumers' concern that agriculture should have more water restrictions. Both urban consumers and environmentalists feel that their central value in long-term, sustainable water security is threatened by the amount extracted groundwater that the agriculture industry uses. The MCWRA has stated that agriculture uses around 90 percent of extracted groundwater, and urban consumers interpret this fact as an indication that reducing agricultural groundwater use could significantly improve water security.[13] The MCWRA is a government agency that manages water resources—their data can be considered objective because their mission does not advocate for either stakeholders.

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[12] Natural Resources Management and Environment Department. n.d. "Keeping the land alive. Soil erosion: its causes and cures..." *FAO Corporate Document Repository.* Accessed Sep. 30, 2015. http://www.fao.org/docrep/t0389e/t0389e02.htm.

[13] Monterey County Water Resources Agency. 2014. *State of the Salinas River Groundwater Basin Report.* Executive Summary, Monterey County.

However, their report about agricultural groundwater use has been presented in the context of extracted water for human use, not total use. Such framework makes the agriculture industry look like they use a vast majority of extracted water; but considering the total amount including environmental use, agriculture uses closer to 40 percent of all extracted water. Despite this contextual clarification, urban consumers and environmentalists still regard the agriculture industry as major consumer that could have a significant effect in conserving groundwater. The fact that urban consumers use 10 percent of groundwater and are required to reduce their use by 25 percent is a source of frustration; urban consumers empirically assume that they are already doing their part by following the mandated water restriction, and that regulating agriculture water use would be more effective in slowing groundwater depletion.

IV. EVALUATION OF POLICY OPTIONS

My policy analysis will be considering ways to reduce extraction of the Salinas River Groundwater Basin and improve water security in Monterey County. The two mutually exclusive policy options I am considering are maintaining agricultural water regulations and increasing agricultural water regulations. I will evaluate each option under three criteria: environmental sustainability, economic sustainability, and social equity. Environmental sustainability will be determined by how well the policy minimizes environmental damage and protects the integrity of the Salinas River groundwater basin and its water. Economic sustainability will be determined by the efficiency of the policy's budget in both monetary terms and resource supply; an economically sustainable option will maintain or increase production profits while minimizing costs regarding groundwater extraction. Social equity will be determined by how the implementation of the policy will affect the various social groups involved in groundwater

extraction. A good, socially equitable policy will have fair implications across stakeholders rather than being significantly more beneficial for one group than another.

Maintaining existing agricultural water regulations would allow the agriculture industry to remain excluded from statewide mandated water cutbacks. The environmental sustainability of this option is rated as a con. The MCWRA has determined that the current rate of groundwater extraction in the Pressure and East Side subareas as unsustainable. Continued pumping in this area will reduce the storage capacity of those aquifers, which allows seawater to enter the aquifer and replace the volume of extracted groundwater. Over the long-term, the continuation of current extraction practices will compromise water security for the county by accelerating seawater intrusion and reducing groundwater storage capacity. Conversely, maintaining existing agricultural water regulations has a pro rating in economic sustainability. Norm Groot, executive director of the Monterey County Farm Bureau, stated that Monterey County farmers have reduced their water usage by 12 percent while producing 45 percent more crops of the last 20 years.[14] The agriculture industry has been able to reduce their water usage while increasing yields in production crops, regardless of their exclusion from statewide water restrictions, which demonstrates success under current regulations. However, maintaining existing regulations poses a slight con regarding social equity. The agriculture industry would not be negatively impacted by continuing regulations as is, nor would they experience any new benefits. Continued regulations would be considered unfair in terms of conservation efforts between stakeholders—the agriculture industry would not be required to reduce their water usage, while urban users continue their mandated 25 percent reduction in water use.

[14] Groot, Norm, interview by Michelle dela Cruz. 2015. *Executive Director, Monterey County Farm Bureau* (October 9).

The other mutually exclusive policy option is to increase agricultural water regulations and restrictions. Limiting agricultural groundwater extraction would have a pro rating regarding environmental sustainability; it would allow groundwater to recharge and maintain storage capacity, which would help mitigate the spread of seawater intrusion. Restricting agricultural use of groundwater would be rated as a con in terms of economic sustainability. Without access to water, crops cannot be planted and farmland becomes fallow; the obvious effect is that unplanted crops would reduce the major economic contributions the agriculture industry provides to Monterey County. However, increasing agricultural water restrictions would have a pro rating in terms of social equity and relative water conservation efforts. Requiring the agriculture industry to contribute the same—or relatively comparable—conservation effort as county residents would have a major impact in reducing groundwater extraction because agriculture still uses a majority of extracted groundwater.

Policy Option	Environmental Sustainability	Economic Sustainability	Social Equity
Maintaining existing agricultural water regulations	Reduces storage capacity which accelerates seawater intrusion (-)	Allows farmers to continue current rate of production (++)	Agriculture industry would not make a relatively equal conservation effort as urban consumers (-)
Increasing agricultural water regulations	Allows groundwater basin to recharge, which increases storage capacity and mitigates seawater intrusion (++)	Prevents farmers from planting crops and using farmland to maintain soil (-)	Balances the conservation effort between agriculture and urban consumers (+)

V. RECOMMENDATION

Limitations

I recommend maintaining current water restrictions and regulations for the agriculture industry, having considered the following factors: limitations of analysis, concessions of the

remaining policy option, justifications, implications, complementary approaches, and accountability. This policy analysis provides an overview of groundwater management in Monterey County and is limited by a general understanding of four major topics. The first limitation in my analysis is having only a basic understanding about groundwater processes such as the replenishment cycle. Without comprehensive knowledge on the topic, I assume that the scientific assessments provided in the MCWRA reports can be trusted as accurate. The Brown and Caldwell engineering firm that conducted the assessments is well established and has been operating for more than sixty years which gives them a fair amount of credibility. However, there is a general consensus among water agencies that more scientific research and understanding will be needed to improve efficiency in extraction and scheduled water replenishment releases from the San Antonio and Lake Nacimiento reservoirs.

My second limitation of analysis is having a limited understanding about the risks of soil erosion following fallowed farmland. Soil erosion is not a main point of contention for the agriculture industry, but I assume it is a risk worth taking seriously because soils are the other major resource required for productive farmland. Monterey County relies heavily on the agriculture industry for economic stability. Compromising the county's major source of income by not securing adequate resources would have serious economic implications, which brings me to my third limitation.

My analysis has a limited understanding about the specific economic implications that would result from major cutbacks in agriculture production, whether by water restriction, soil erosion, or both. I concur with the general assumption that compromising agriculture production would have detrimental effects on the local economy in Monterey County. I find this a reasonable assumption because agriculture is Monterey County's primary economic industry.

Tourism along the coastal cities also generates a fair amount of income, but cities within the Central Valley, such as Salinas or King City, would not be able to rely on tourism if agricultural production declined. My analysis could be stronger knowing what the ripple effect might be if crop production were reduced in Monterey County.

Finally, I am most limited in my understanding of urban consumers as a cohesive stakeholder. There may be local government figures that may act as the representative organization of urban consumers, but I assume that opinions would vary greatly among residents and business owners. The fact that people in the agriculture industry are also urban consumers at home also makes residents a complicated stakeholder. The best assessment of residential attitudes regarding groundwater could be achieved with a qualitative poll or survey. Without this data, the best accessible sources of resident opinion are individual responses to media reports. In this light I found that many residents have had adverse reactions to agriculture's exclusion in mandatory water conservation. However, these responses—and even those that could result from a formal poll—have statistical limitations in response biases.

Concessions

In my recommendation to maintain current water policies on agriculture, I will also describe the concessions regarding the policy of increasing agricultural water regulation and its advantages. I acknowledge that increasing agricultural water regulations would make the greatest impact in replenishing the Salinas River Groundwater Basin. Despite the clarification that agriculture uses closer to forty percent of the total water supply in California, the agriculture industry is still a major consumer regarding human water use. Restricting agricultural groundwater extraction could have a significant effect in increasing water resource sustainability and security. Consequently, reducing groundwater extraction would also be more beneficial for

the environment by maintaining storage capacity in the aquifers and slowing the rate of seawater intrusion.

Justifications

My initial position was to increase agricultural water regulations because it would make the greatest difference in groundwater conservation, and I tend to favor environmental protection policies because I am an environmental studies student. However, my interview with the executive director of the Monterey County Farm Bureau was effective way of gaining a new perspective on how water is used locally—the practical consequences in society from limiting agriculture—which I had not critically thought about. Having considered the prior limitations and concessions, maintaining agricultural water restrictions is justified because Monterey County relies heavily on the agriculture industry for economic contribution and job security. Therefore, I am giving greater weight to the economic sustainability criteria mentioned in my policy evaluations. Monterey County does not have a diverse selection of economic industries to account for losses in agriculture; in other words, Monterey County would not be prepared to replace agriculture-related jobs and rely on another industry for lost economic contributions. Restricting groundwater access is an aggressive approach that could be avoided by implementing other complementary approaches to conserve groundwater and achieve water security. I recommend giving the agriculture industry the opportunity to use other policies and technologies to

Complementary Approaches

In addition to the 2014 Sustainable Groundwater Management Act, Senate Bill 20 (SB20) was introduced by Senator Fran Pavley in December 2014. Initially SB20 proposed to make water well data reports available to the public, which could have provided valuable information

about local subsurface geology.[15] Such information could reveal more conclusive relationships between soil composition and infiltration or recharge rates that might improve techniques and scheduling of efficient groundwater pumping. However—as of August 26th, 2015—SB20 was amended as the California Water Resiliency Investment Act. Although SB20 no longer relates directly to groundwater, it sets a framework for funding water resource projects in California.[16] Successful water projects could help the agriculture industry manage groundwater without significantly limiting their access to groundwater.

Some proactive complementary approaches include technologies such as recycled wastewater facilities, best practice irrigation techniques, and desalinization plants. The effectiveness of these technologies is supported by the previously stated fact that Monterey County agriculture has 12% less water and produced 45% more crops over the last 20 years. My interview with Norm Groot revealed an often overlooked, but potentially effective approach to recharging the Salinas River Groundwater Basin—clearing out water intensive non-native plants along the Salinas River. Groot expects that clearing out the invasive vegetation could provide an extra 40,000 acre-feet of rechargeable groundwater per year.

Consequences and Implications

An unwanted consequence of maintaining existing agricultural groundwater regulations would be over-extraction of groundwater to the point of losing accessibility, and the full compromise of a subarea in the Salinas River Groundwater Basin due to seawater intrusion. Land subsidence would not be expected at the coastal sub-basins such as the Pressure subarea because intruding seawater would replace the pore spaces of extracted groundwater. However,

[15] Clean Water Action. n.d. *Unlocking Secrets About California's Groundwater*. Accessed November 13, 2015. http://www.cleanwateraction.org/feature/unlocking-secrets-about-california's-groundwater.
[16] 2015. *SB 20: California Water Resiliency Act.* Senate Bill, California Legislative Counsel.

inland basins such as the King City subarea could be susceptible to land subsidence because extracted water would not be replaced, allowing soils and pore spaces to collapse and compact. Social implications of over-extraction and seawater intrusion start with the failure to secure water for urban consumers and farmers. Without water farmers would have no choice but to fallow their land, which could result in a detrimental ripple effect for the local economy. First, the primary farm workers would lose their jobs due to unplanted crops. Then, agricultural support businesses such as processing packaging plants would also lose work because there would be little crop production to process. It's possible that local populations could decrease as a result of rising unemployment rates and people looking for jobs. At that point, smaller populations would negatively impact all businesses in general.

Accountability and Conclusion

The Monterey County Water Resources Agency would be held accountable for monitoring groundwater levels and taking precautionary measures to prevent over-extraction of groundwater from the Salinas River Groundwater Basin. By 2017, groundwater sustainability agencies should be established for various basins across the state, as mandated in the California Groundwater Sustainability Management Act. Ultimately the Monterey County's goal for water security will be securing economic sustainability by having agricultural production reflect the reality of the surrounding environment and resources. In the meantime, allowing Monterey County farmers to implement and develop efficient water use practices and technologies will help create a smoother transition towards that goal of water sustainability.