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State Run Dry: How California Manages Inevitable Drought Due to Climate Change

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Abstract

This thesis paper addresses the severe drought brought on by climate change that California is currently experiencing and examines methods to counter the drought in order to minimize water usage and increase water levels. Historically, California has experienced several periods of drought which are increasingly becoming more detrimental to the environment. It is crucial to mitigate the drought as California has already been feeling its major effects from it. As temperatures rise and the atmosphere becomes drier, the water supply in California could be diminished by 10% by 2040. Chapter 1 uses several studies and reports on the California drought to analyze the rate of water loss and reveals the negative effects of water shortage. It also provides data on the increasing severity of climate change and the factors that induce it. Chapter 2 explores the negative externalities the drought has brought on the economy, especially in the agriculture industry, as water is in higher demand, more than ever. California is America's Garden, producing most of the fruits and nuts grown in the United States. However, the future of the agricultural economy does not bode well with the current drought. Chapter 3 focuses on the history of drought as it has been prevalent in California, with the first severe drought dating back to 1924. While there has been some progress from the previous droughts, such as an increase in water recycling, the groundwater supply continues to be critically low. Chapter 4 draws on policies and regulations set by the California government as well as how effective media is in conveying these messages to reduce water usage. Chapter 5 lists policy recommendations, drawing from the previous chapters that will not only work to aid California residents in combating the drought but also aim to help the state reach its water level target.

Keywords: drought, climate change, California, agriculture, environmental economics, media coverage, environmental history, public policy

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Introduction: *Another Drought for the Books*

Over the decades, California has experienced many severe droughts because of its arid weather, lack of precipitation, and climate change. They are known for receiving little snow and rainfall therefore, there is not enough water to replenish groundwater sources, rivers, or reservoirs. Of course, there is no way to create rainfall or speed up the summers, so policies need to be implemented regionally and statewide to mitigate the effects of the drought and prevent future ones. Droughts are no doubt detrimental to the environment, with social, economic, and environmental implications. Both the quantity and quality of water are negatively affected and can even lead in a permanent loss of ground water storage in extreme cases. Water supplies, especially from freshwater, is typically diverted away from ecosystems which causes water level in rivers and lakes to decline while increasing the risk of death for organisms that live in these habitats. In some extreme cases, it can also lead to extinction. Agriculture is heavily affected by the drought because water allocations may be severely cut from the state, so farmers must adapt to these changes by increasing groundwater pumping, changing the types of crops they grow, drought-resilient irrigation, or even leaving their lands fallow. Rural communities run a huge risk of water scarcity because they are usually dependent on a single water source which can lead to negative economic impacts. The California government, more than ever, is taking initiative right now it trying to help mitigate the drought through local water agencies and residents because they know the detrimental consequences of this crisis. Within the past few years, there have been policies implemented by Governor Gavin Newsom as well as Governor Jerry Brown to conserve water and combat the disasters of the drought, but the California's future looks bleak if there aren't more measures taking place.

Chapter 1 provides quantitative data regarding the California drought as well as the cause-and-effect factors. It reveals that climate change is the largest factor behind the drought. This chapter also heavily focuses on California's water resources. Chapter 2 discusses the economy of the drought, where government money is being allocated to as well as the financial state of a variety of different sectors. It demonstrates how business are either failing or thriving based on what they offer. Chapter 3 goes in depth on the historical droughts in California and key takeaways from past droughts. It also compares each drought to each other. Chapter 4 ties media and government policies together to discuss how they are using everything available to them to spread awareness about the drought. It also discusses existing policies enacted to help mitigate drought effects. Chapter 5 includes policy proposals for different sectors and methods that they could be implemented to help mitigate the drought and prevent it from worsening. It also includes preventative measures that can be taken to make sure the drought has a lower chance of coming back.

Chapter 1: *Will California Sink or Swim?*

The drought in California has been progressing very rapidly and is affecting 37.2 million California residents. On February 11, 2020, the state was declared to be in a drought when drought conditions had first appeared in about 10% of the state. In mid-May 2021, 100% of California was experiencing drought conditions. A few months after in July, Governor Newsom encouraged California residents to reduce their water usage by 15% but it was not mandated, merely a suggestion. CalMatters reports that "residential water use statewide in August 2022 decreased to 105 gallons per capita used daily compared to the five-year average of 116"

(Becker). This is partially due to water suppliers estimating or reporting the amount of water used for residential purposes monthly and reporting back to residents.

Climate Change. Climate change plays a very large role in the current drought especially with the growing population and demand for water. The drought in California is one of the largest signs of climate change. Snowpack in the mountains is decreasing as the temperature increases but the snowpack accounts for about a third of California's water supply. The snow is usually accumulated during the winter and when spring and summer time comes around with the dry climate, the snow is slowly released. However, because the winter temperatures are continuously increasing, the snow melts fast and earlies which makes it difficult for storage and usage during the dry seasons. According to California Department of Water Resources, "this significant decrease in snowpack has a direct impact on water supply for Californians". The main source of California's water supply system in the Sacramento-San Joaquin Delta and serves over 25 million Californians and millions of acres of farmland. However, the rising sea levels due to climate change is bringing more saltwater into the Delta. To flush out the saltwater, freshwater needs to be pushed through the Delta which minimizes the usage of people who really on the water. The warm temperatures are also enhancing evaporation causing soil to dry out.

Ecosystem Services. The climate change in California has heavily affected the water-related ecosystem services. "During the top five drought years, on average, a 22% decrease in precipitation led to reductions in streamflow by 37%. In California, the decline is much more substantial, with the majority of the stations studied exhibiting more than 75% declines in streamflow during the same period." (Chang 2016). The effects of climate change have been

much more severe than the national average leading to major water shortages. Because of California's arid climate as well as the growing population, the water demand will only continue to increase.

Climate change has also affected water quality around the world, especially in California, with water temperature change, dissolved oxygen levels, and nutrient loads. Because of the change in water quality, the conditions of rivers and streams have become extremely harmful and are threatening vulnerable fish species. The low flow of water in rivers and streams leads to an increase in salinity. California is home to many diverse species of animals and some of them have adapted to the drought. However, as the drought worsens, so do the implications. The food chain has become severely affected. Because the conditions are dry, animals at the bottom of the food chain have less plants to feed on leading to more deaths. This goes all the way up the food chain. Predators have less to eat as well. Aside from the food chain, many small animas also have a small area where they can travel, so they cannot migrate to other locations for food and water. For larger animals such as deer and bears, a lot of them migrate to one area where they are densely packed. Because they are so close and they bodies are weak, diseases spread more quickly within the area.

Birds also travel along California when they begin to migrate. They pause in California to refuel and replenish with nutrients, however it may be a permanent pause for them. One of the largest rest stops for the migrating birds is the Klamath region but 2021 has been the driest year on record. The U.S. Fish and Wildlife Service reported that the Lower Klamath Basin is "almost completely dry". What used to be around 1.5 million ducks that showed up in the area is now around only 34,000. Even though ducks and geese are extremely resilient and can fly for days nonstop, this drought has become too severe for them. According to Cal Matters, "resting and

feeding spots at wildlife refuges are overcrowded this year, which can foster spikes in the infectious or water-borne illnesses spread by close quarters. Avian Botulism and cholera, present even in wet years, spike in arid times". It was reported that a botulism outbreak in the Klamath Basin killed around 60,000 and probably many more. It is not just the Klamath region that is in bad condition. The wetlands further south of the Klamath are also suffering, such as the Sacramento River National Wildlife Refuge. The waterfowl count dropped by 200,000 from 2022 to 2023.

Water Supply Levels. According to the current U.S. Drought Monitor (USDM), 99.5% of California is experiencing at least moderate drought, 85% is experiencing severe drought, 40.9% is experiencing extreme drought, and 12.7% of California is experiencing exceptional drought. California is currently in a three-year dry period and is looking at another dry year in 2023. Moderate drought is characterized with stunted dryland pasture growth, lower stock ponds and creeks, and changing wildlife patters. Severe drought consists of inadequate grazing land, longer fire seasons with high burn intensity, and stressed trees. Extreme drought which almost half of California is experiencing means livestock needing expensive supplemental feed, cattle and horses must be sold, little pasture rains, year-round fire seasons even in wet parts of the state, and inadequate water for agriculture, wildlife, and urban needs.

California is known for having arid springs and summers, so droughts are expected, however not at the severity that it is currently at. During these seasons, California mainly relies on reservoirs and melted snowpack but as of 2022, the winter has been the driest California has ever seen in over 100 years and it is only getting worse. The drought is not solely caused by the lack of rainfall or snow but also the warming temperatures, where 2021 had the warmest summer

on record. “Some parts of the Sierra Mountains that typically have 66 inches of snowpack are barren” (seametrics.com). Because the climate becomes so hot and dry, plants and soils require more water to thrive which leads to an increase in demand for water and reduces the runoff that is supposed to flow into the reservoirs. John Abatzoglou, a professor of climatology at UC Merced comments “that’s taking what’s already been a really rotten, worst-in-the-instrumental-record precipitation drought and making it into even a worse drought”. Daniel Swain, climate scientist with UCLA and The Nature Conservancy claims that the fate of California is dependent on how the storm track shifts but they are very difficult to predict. “I would still put my money on dry, even in the northern third of the state. It’s not a guarantee. But if you were to see 50 winters like this one, most of them would be dry.” (Swain 2022). It was reported that temperatures were about 3 degrees Fahrenheit about the 20th century average from 2020 to 2022. The evaporative demand was increased by 3 to 5 inches.

California will be entering the next year with a water deficient, and an average year of precipitation will not be enough for them the state to recover. In almost two-thirds of the wells, groundwater levels have sunk below average and reservoir storage is at 69%. Though this is an improvement from 2021, the numbers are still well below where it should be or where it needs to be. Facing the reality of the future, local farmers have already started to cut back on planting crops for fall and winter. More fields than ever before are expected to be fallowed because farmers are deciding not to plant annual crops such as tomatoes, melons, and corn to preserve their water supply for permanent crops.

The Colorado River, a large source for California’s water supply, is in worse conditions now than it was in the previous drought with its reservoirs hitting historic lows. The Public Policy Institute of California (PPIC) states that “The Colorado River supplies roughly a third of

all water for Southern California cities and suburbs. It also supports a large farming industry in Imperial and Riverside Counties" (PPIC 2018). California shares The Colorado River with 6 other states, Wyoming, Colorado, Utah, New Mexico, Arizona, and Nevada, as well as Mexico. "Climate change studies project an overall decline in the river's water, which will exacerbate the imbalance of supply and demand" (PPIC 2018). Because the river's water levels are declining, a group of California's water agencies, that consume the largest proportion of water, are voluntarily offering to get their water usage. They are proposing to reduce their annual allotment by 400,000-acre feet which is equivalent to around 130 billion gallons of water. In return, they would need $4 billion in drought relief funding from the government. Though this is a step in the right direction to mitigate the drought, it is not nearly enough. The Central Valley Project is another one of California's main water suppliers. About 20% of California's water is stored and distributed through their system of reservoirs and canals. They are just beginning their 2023 water year with the lowest starting point in recent years with 3.6 million acre-feet of water storage.

Governor Gavin Newsom, the current governor of California states, "Our hots are getting hotter, and our dries are getting drier. Our state is on track to lose 10% of its water supply by 2040 which is why we must do all our part to conserve water." He believes that it is of utmost importance to search for new strategies to combat the drought. There is no short-term solution for the California drought, due to the never-ending arid conditions and climate change. The drought has become California's new reality since it has been going for three consecutive years as of right now. As of 2022 there are over $5 billion in investments supporting drought response and is being allocated to build drought resilience in the future. It is important to look into the long-term future of water for California as the drought is continuing to worsen. Newsom states

that “with the climate crisis threatening communities across the West, we must double down on our work to build water resilience in our communities for the long haul”. One large impact that the drought has right now and will continue to have on California’s land is the risk of wildfires. The dry and hot conditions make forests more susceptible to fires. They are also becoming increasingly more difficult to put out because of the diminishing water supplies. These wildfires pose a risk to residents living near the forests as well as reducing ecosystem services and biodiversity.

Agriculture Water Usage. 80% of all the water used in California can be pointed towards agriculture. California produces over 400 commodities which include almonds, walnuts, lettuce, tomatoes, strawberries, and grapes. In 2021 the almond and pistachio acreage grew and so did the water usage, by 523 billion gallons of water which is enough to supply 87% of Californians. Many of these Californians lack access to clean water. However, California supplies products to Americans across the country so slowing down production would be difficult. “California farmers produce more than a third of the nation’s vegetables and two-thirds of its fruits and nuts” (nytimes.com). Growing these products require so much water for example, a sliver of an avocado takes 4.1 gallons and merely 16 almonds require 15.3 gallons of water. According to the California Department of Water Resources, “In an average year, approximately 9.6 million acres are irrigated with roughly 34 million acre-feet of water; an amount that would cover 31 million football fields with 1 foot of water. Most of this irrigation is used very efficiently”. Since agriculture uses most of California’s water resources, making small changes to watering methods could make a drastic difference. The drought makes it very difficult for those working in the agriculture sector because many workers are out of jobs or at risk of losing their job and not

bringing in an income to their family. The demands for products will only increase and the population of the United State increases, so there is no slowing down agriculture production willingly in the foreseeable future.

Livestock Water Usage. Even though the agriculture sector takes up so much water, the livestock sector is not too far behind. The amount of water needed to produce meat, dairy, and eggs, trumps the need of crops. An average human consumes less than one gallon of water per day, but cows drink up to 23 gallons. For every minute the shower runs, about 2 gallons of water flows out. For every pound of beef that is produced, 2464 gallons of water is needed. To put into perspective, replacing a pound of beef with plant foods would save more water than not showering for 6 months. Not only do the animals consume a lot of water but it requires a lot of water to maintain them. According to One Green Planet, "Millions of additional gallons of fresh water go to irrigate the feed for livestock, to wash excrement off the concrete floors, to clean the blood and grease from the equipment in the butchering process, and further uses that are not necessary in plant food production". Also, growing feed for the livestock takes about 56% of the water in the US.

Lake Mead. Located along the Colorado River is Lake Mead, the United States' largest water reservoir that spans for hundreds of miles on the borders of eastern Nevada and western Arizona. Lake Mead and Hoover Dam supplies water and power to around 25 million people in the west and plays a vital role for major cities and agriculture areas. Lake Mead was created during the Great Depression to support urban and industrial expansion to ease the effects of the dry and arid climate. The issue with Lake Mead is that it "has to remain above a certain elevation

to pass through Hoover Dam, a process that facilitates the distribution of water as well as generates hydroelectric power to water and irrigation districts as well as municipalities across Arizona, California, Nevada and Mexico" (cbsnews.com). In July 2022, Lake Mead has reached the lowest level ever seen since it was first created. It was reported to be at 1,043 feet above sea level and the threshold to operate hydropower turbines is set at 1000 feet. It was standing at 26% total capacity and the Colorado River was only 10% higher. According to Greg Postel, a meteorologist at The Weather Channel, "Less water is flowing through the Colorado River system because of a persistent upper weather pattern that hangs over the West" (cbsnews.com). He reports "that upper-level pattern is something that climate scientists believe is going to become more and more prevalent in a warming would with climate change. In other worse, we're kind of stair-stepping our way toward drier times" (Postel). When the system was first established, each state was given a set amount of water they could take from the river but what was not considered was how much the river flowed, or lack thereof. Both Arizona and Nevada fell victim to the mandated cuts in 2022. In 2023, Arizona is going to be cut by 21% and Nevada by 8%. However, California was not mandated to reduce their allocated amount. California is the largest water receiver from the Colorado River. There are two canals that stem from the Colorado River that divert just to Southern California which provides irrigation and hydroelectric power to 600,000 acres of farmland. Even though California has not faced federal cuts, there are still huge losses because of the lack of water.

Lake Powell. The second-largest reservoir in the United States is Lake Powell, who accompanies Lake Mead. It's an artificial reservoir that was created when Glen Canyon was flooded in 1963. Lake Powell has a 24m acre-feet capacity, but it is now at 28%. In March 2023,

the water level reached 3,525 feet and if it were to drop another 32 feet, it would not have been able to generate anymore hydropower. The Bureau of Reclamation believes that even if there are significant water allowance cuts, there is still a 23% chance that in 2024, power production could be put on pause. This could also happen as soon as July 2023. States will continue to fight for resources over whatever water is available and will only continue to get worse. “When the lake is full, its dam can produce 1,320 megawatts, or 5bn kilowatt-hours for power annually – about the same amount as a large fossil fuel plant. But with water levels now 100 feet below the lowest elevation marker, hydropower production has dropped to 800 megawatts” (theguardian.com). there are so many unprecedented changes that are being made as California is in a state of emergency. Lake Mead usually receives 500,000 acre-feet of water but over the year, Lake Powell will not be able to distribute it. Instead, Lake Powell will receive 500,000 acre-feet of water from the Flaming Gorge Reservoir in Wyoming. Jack Stauss, a member of the non-profit Glen Canyon Institute, says the importing water from other reservoirs is just a “simple band-aid fix” that will only solve the problem in the short term. It will not fix existing issues. Since Flaming Gorge has merely a fraction of capacity compared to Lake Powell, it will soon be drained if this continues. The Glen Canyon Dam currently supports 50 Native American tribes. If levels were to be minimal, rural, and low-income communities would be greatly affected. They would have to resort to coal or nuclear energies which for one, is more expensive and two, not sustainable. The price for hydropower may increase up to 40%. The Navajo Tribal Utility Authority serves 43,000 residential and commercial customers and operating costs were forecasted to increase by $4.5 million in 2022.

Central Valley Water Supply Conditions. The Central Valley Region of California is essential because of their reservoir storage and agricultural practices. In 2019, their reservoirs were close to being full. However, in 2020 with the lack of precipitation, the water stored in reservoirs was noticeably starting to decrease and in 2021, the reservoir had reached drought levels. Tulare Lane and the San Joaquin River reservoir were at very low levels, but the Sacramento River had it worse and is in very critical condition. The water supplies in the Sacramento Valley during this period is very similar to 2015, when California was in severe drought. In California as a whole, 752,000 acres on land were estimated to be left idle with 696,000 acres of them being a part of the Central Valley. The Sacramento River Basin resulted in a lot of idling in 2021 and 2022 because of low surface water deliveries, water transfers to activities outside of the basin, and a less developed groundwater pumping infrastructure.

The drought in California poses many threats if it continues at the rate it is at currently. The most obvious one is water supply shortage especially in communities who cannot afford water rates. There will be limited access to water for everyday household tasks including cooking and cleaning. The water costs will only continue to increase as supplies run low and demands remain the same or even increase. Agriculture will also be negatively affected in most regions in California. Each drought in California from 2011 to 2020 has caused at least $1 billion in damages. As mentioned before the drought is only worsening, so if there is no drought relief of mitigation soon, California will soon heavily experience the negative effects.

Chapter 2: *Which Will Go First: Money or Water?*

California has one of the largest economies in the nation, but the drought is negatively impacting it, especially due to the agriculture sector. Most of the nation's products are grown in

California, which uses 80% of the state's water. Many businesses have been affected due to limited water allocations and restrictions put in place. Some businesses are thriving based on how helpful they are to residents. A lot of low-income communities have also heavily been affected because they do not have the same accessibility to clean water compared to wealthy neighborhoods. Governor Newsom is also allocating a lot of state funding to mitigate the drought, but the water sector may need more than just money.

Agriculture Sector. 40% of California's agriculture comes from groundwater during normal weather years but during the dry years, groundwater pumping increases because of surface water reduction. "Increasing groundwater withdrawals to offset reduced surface water is not sustainable. The depletion of aquifers has forced individuals and communities to dig deeper wells or find alternative drinking water sources, increasing the cost of energy needed for pumping or water diversion" (Chang 2016). The policy brief from April 2022 from the PPIC, "Drought and California's Agriculture" highlights how California has the nation's largest agriculture sector, but water is a huge concern right now.

"The industry employs over 420,000 people and generates more than $50 billion in annual revenue" (PPIC 2022). Because the drought has been so prevalent, farmers have adapted to improve productivity by shifting to crops that require less water and will generate more profit. From 2020 to 2022 the statewide precipitation for their water-years was only 68% compares to the 20th century averages. Apart from lack of precipitation, the temperatures were also way above average so there was an additional three to five inches of evaporation. Even though there is an improvement in irrigation efficiency, water availability continues to be a concern. This drought is very taxing on soil and vegetative moisture, and irrigation requirements with only

increase as the land continues to deteriorate from these drought conditions. The highest revenue losses stemmed from a few annual crops that had high per acre revenue (northern basins) and there was reduced yields in non-fruit trees and vegetables and veins (coastal area). “Surface water shortages increased groundwater pumping and other production costs. To lessen drought impacts, farmers increased pumping by nearly 4.2 maf compared to 2002-2016, which was not enough to replace all lost surface water” (PPIC 2022). This caused farmers’ energy bills to rise by about $184 million. Sometimes farmers just leave some croplands unplanted, idling or fallowing, and typically do this with less profitable crops. The total land that was idled because of the drought in 2021 was about 395,000 acres. Some farmers have also reduced watering crops below the crops needs, also known as deficit irrigation, to stretch out their available supplies, however this lowers their crop yield. “Across impacted regions, crop revenue losses and increased pumping costs were estimated at $1.1 billion, with roughly 8,700 full- and part-time jobs lost” (PPIC 2022). According to a Joe Del Bosque, a farmer in California, in an interview with CNN, “I got the land, I got the people, I have everything but no water. I can’t do it”. He is one of the many Latino farmers affected by the drought and they are forced to make difficult decisions on how they want to proceed. Allocation have been reduced for irrigation in Central Valley and only a limited number of customers would be able to receive water deliveries from underground reservoirs. Bosque mentioned that he had to stop growing asparagus and sweet corn and left those lands idle. About 100 farmers were out of a job because he was not able to hire them, though they had worked for him for many years. “Worried about being able to afford rent, childcare and higher gas prices, farmworkers are starting to look outside agriculture to supplement their income” (Chavez 2022).

The drought is impacting the prices for key crops which will inevitably drive inflation higher for consumers, putting a strain on Californians. Inflation of the U.S. is now the highest it has ever been in 40 years. Don Cameron, the President of the California State Board of Food and Agriculture said that “There’s just not enough water to grow everything that we normally grow”. Many crops have been harvested a few weeks earlier than ready to prevent from further drought damage. The USDA reported that the drought and high temperatures in California has made it difficult on farmers to grow enough tomatoes to meet the market’s demands. California is responsible for growing 30% of the world’s processing tomatoes but for 2022 it is forecasted to be down 10% from 12.2 million tonnes to 10.5 million tonnes. Because of this shortage, farmers are asking for higher prices for tomatoes, onions, and garlic which are all used for spices in boxed meals and grocery store staples. According to Don Cameron, the President of the California State Board of Food and Agriculture, “What you’re seeing harvested this summer that really hasn’t even hit the grocery shelf is a 25% increase in the cost of the product to the processors – the canner, the buyers downstream. The onions and garlic have already been negotiated for 2023 with another 25% increase in price”. The U.S. Department of Labor reported that food prices went up 11.4% annually and each month it rises by .8%. Kraft Heinz Co, a large industry for ketchup and tomato-based pasta sauce, is getting their tomatoes from other states and countries because of California’s shortfall.

Industry employers such as warehouses, fertilizer dealers, and mills, are also laying off workers because of the drought. Many of these facilities are being shut down and are not scheduled to reopen. According to California Rice News in “Critical Perspectives on Drought’s Impact on Businesses”, “unemployment has spiked for jobs that support farming. In turn, whole communities are affected: schools, local stores, and social services”. Because agriculture is

directly affected by the drought, everything that is associated or interacted with farming is indirectly affected as well.

Livestock Industry. The drought in California has heavily affected the livestock industry because of the increase of cost and the decrease in availability for feed. Cattle in California is the fourth-largest agricultural commodity valued at $2.74 billion in 2020. According to the research report, “Economic Impacts of the 2020-2022 Drought on California Agriculture” that was prepared for The California Department of Food and Agriculture, “In 2022, California’s drought reduced forage availability substantially and raised costs for purchased forages for the cattle grazing industry, which brings billions of dollars of farm revenue to the California economy” (Medellín-Azuara 2022, 18). Despite the lack of rainfall causing a problem for forage costs and availability, cattle producers are benefitting from the increasing prices of cattle that were sold. Dairy prices are also expected to increase, exceeding $8 billion in 2022, continuing to be the largest part of California’s agriculture revenue. However, without enough supply this is going to continue to be a problem as the population increases and people demand more livestock products because there is not enough supply. According to Business Insider, “the cost of beef in US cities rose steeply from March 2021 to March 2022, increasing 16.7% for steaks and 25.4% for other beef. Steak prices reached a record high of $10.23 a pound in November, and ground beef hit its own high of $5.41 a pound in April.” Since the drought seems endless for a while, the beef market is most likely to be elevated for the foreseeable future.

However, the USDA’s Farm Service Agency has disaster assistance programs to ensure farmers’ economic security. Their Non-Insured Crop Disaster Assistance Program aids famers with non-insurable crops with financial assistance if their crops have low yield, loss of inventory,

or prevented planting. The Livestock Forage Disaster Program will compensate livestock farmers who are victims of grazing losses due to drought on privately owned or cash leased land. The Emergency Conservation Program is essential for farmers because it "provides emergency funding for farmers and ranchers to rehabilitate land severely damaged by natural disasters and to implement emergency water conservation measures in periods of severe drought" (cdfa.ca.gov). Not only will this provide them with financial security but will also give them the means to combat the drought.

Fishing. Salmon plays a large part in California's economy, but NPR reported that "Chinook salmon fishing off the California coast will be called off until next spring", 2024, in anticipation that a near-record-low number of fish will return to the state's rivers to spawn", which was recommended by the Pacific Fishery Management Council that oversees West Coast Fisheries. This bans both commercial and recreational fishing across California. The council says that Chinook salmon are the "largest and most highly prized" compared to the Salmon in the Pacific Ocean, but it has become more endangered as drought and climate change progresses. The fishing industry holds about 23,000 jobs in California and cancelling salmon fishing season will heavily take a toll on the fishing economy which is valued around $1.4 billion. Similar to families in the agriculture sector, many fishing families have also felt the effects of the drought when they bring in a lower income than usual.

Recreation Many recreational businesses were putting on hold or permanently shut down due to the drought. In an NPR report "California's Ongoing Drought Hits Water Recreation Business", reporter Rott tries calling the business, Kern River Outfitters, but was met with a

voicemail. The voicemail said, “Hello, and thank you for calling Kern River Outfitters. Due to the drought, we have decided to not operate for the 2015 season”. They then brought on John Davis, the owner of the Riverview Lodge in Kernville. He said that “in the last four years with the drought, [his] overall business, or revenue anyway, is down about 30 percent”. The recreation economy cutback is not just in Kernville, it’s in almost every mountain town. Another business that has been suffering is fishing. For example, Off the Hook Fly Fishing located in Napa had to shut down their daylong excursion experience because the water would get way to warm later in the day. According to the owner Mike Copithorne, “trout especially are very susceptible to warm water. They need cold water. At about 60 degrees they start dying. With catch and release, the mortality rate increases if you handle them too often, especially in the heat of the day.” Because the business no longer offers all day excursions, their booking had reduced by 10%. Golf courses in California have also fallen victim to the drought. The Marin Municipal Water District mandated a 40% water use reduction where Mill Valley Golf Course is located. The workers must be very wise in where they choose to water and which areas they have to sacrifice. Many health clubs and gyms, such as Body Kinetics Health Club, have limits for the time people can shower.

Fashion. To dye the fabric to make 1,500 t-shirts, it takes approximately 3,200 gallons of water. The process of making denim also consumes so much water, making the fashion industry the third largest user of water globally. When Lafayette Textiles in Vernon, California was at the peak of its business, they had 200 employees but four years after, it was on the verge of completely shutting down. Sean Zahedi, the son of the owner of Lafayette Textiles said that his “father used to have his own dye house. But because of rising labor costs, environmental

regulations, and water, it moved to Nicaragua". This is the same for many other manufacturing plants in California. They have moved to other states of countries where water is more abundant. Many businesses that require so much water such as dye houses, were mandated to turn their water off for a certain period every day.

Saitex USA, a manufacturing plant in California for denim has created a very water efficient plan. The founder Sanjeez Bahl stated that "The population continues to increase, and our resources continue to get depleted. So, if there is a methodology to conserving and preserving, we have to showcase that". The company is not keeping their process a secret and is willing to share it with anyone. Saitex USA uses water-saving equipment that recycles 98% of their water eternally while the other 2% evaporates. However, while Saitex save around 50-60% in water costs, the initial investment into their technology is very high and they won't see a payback for the next 6 or 7 years.

Low-income Communities. Low-income households in California can receive assistance from nonprofit organizations if they cannot afford to pay their electricity bill. However, the same assistance is not available for water. A high-water bill tends to be an economic burden for many of these families and according to the LA Times, 1 in 10 California households are falling behind on their water payments. It is estimated that about 13 million Californian's experience troubles with paying their water bills as prices continue to only increase. According to the legislature passed in California, "every human has a right to clean, safe, and affordable drinking water" but state officials have yet to fulfill this basic right. As of recently, Governor Newsom vetoed a legislation that requires all community water and wastewater systems to aid residential water consumers. His reason for vetoing this was because the program lacked a source of funding. He stated that "signing this policy would result in significant General Fund pressures in the billions

of dollars to continuously provide such assistance". Water affordability advocates believe that Newsom really overestimated the cost of this program and the water board reported that the program would have only needed $200 million a year, not billions that Newsom thought. Even if the bill did lack funding, it would have still been an important step to start the initiative.

David Mitchell, an economist that specializes in water, studied that water utility prices are rising faster than other "big ticket" items such as medical bills or college tuition across California. He says, "cost containment is going to become an important issue for the sector in the coming years" (Mitchell 2022). According to the Nasdaq Veles California Water Index, on October 20, 2022, water prices increased by 40% since the start of the year. It has reached $1,028,86 for merely an acre-foot. The long-term factors of rising water cost are the replacement of old, aging infrastructure, new water treatment stands, and investments of insurance, projects, and storage. The short-term factors are drought restrictions. When people use less water, urban water utilities earn less revenue because they usually have fixed costs. Comparing 2015 to 2007, families were paying 45% more per month which main affected low-income communities and well as households with people of color. Since 2021, the number of dry wells has increased by at least 70% and there are around a million California's who live with contaminated drinking water. Not only are these low-income communities unable to afford clean, or even enough water, to survive, but as prices for crops rise, they are going to have difficulty paying for groceries. The lack of attention for these communities is very concerning.

Farmers have been learning more as the drought continues, how to make agricultural systems more resilient. However, COVID-19 presented a threat to the agriculture sector. With the combination of COVID-19 and the drought, it immensely affected crop yield and global food chains. The pandemic impacted water usage, as people were quarantining and spending more

time at home, leading to increased water usage for cooking, cleaning, and hygiene. There was a survey done in the beginning of 2021 on the COVID-19 impact on the economy of the water sector. It was discovered that 12% of California families were late or did not pay their water bills. There was an average debt of $500 per household and Californians in its entirety are in debt of $1 billion, with $600 million just for drinking water. Some cities in Los Angeles County such as Willowbrook and Compton receive discolored and contaminated historically because they are disadvantaged communities. There are programs that is run by the state that offer their continuous support for utilities and essentials but not for water. The California Water and Wastewater Arrearage Payment Program was enacted because of the drought and the pandemic but they only offer one-time funding assistance for those households facing debt, which is not enough relief for these residents. Since COVID-19 has had negative economic impacts, the budget to respond to the drought has been strained.

According to Green matters, “California’s economy is *literally* bone dry after an ongoing drought has sucked up entire bodies of water and killed off thousands of acres of crops” (Rosenberg 2022). The lack of water in the agriculture sector has created chain of economic loss. It affects farmers, to grocery stores, to the entire state economy. California relies on tourism for a lot of the money because of fishing and water sports but this has been hindered because of the drought. According to Governor Newsom’s website, “over the last three years, the Governor and the Legislature have earmarked more than $8.8 billion to modernize water infrastructure and respond to the drought”. The state budget for 2022 is about $3.6 billion form multiple years collectively for drought resilience and response. There is a historic three-year $5.2 billion investment in the water systems of California which includes $75 million for the Save Our Water campaign.

Opportunities. While for most people the drought has had negative economic impacts, it has also given some businesses to be innovative and capitalize on their resources. For example, River's Edge Kayak and Canoe Trips in Healdsburg are still finding out ways to make ends meet. The manager of River's Edge, Rochelle Collier, stated that "as long as there is water and not any dry land areas, we will continue to put people on the river". Even though the river is drying up, there is still water there and weekends are still being sold out. The new owners of River's Edge compensated for the lack of water by implementing new activities to attract people to keep supporting their business. They now have live music and rental chairs on Fridays and the weekends.

Some businesses have greatly benefitted from the drought such as laundry facilities, plumbing, and well digging. Gaeton Tamo, the owner of 14 laundromats in California reported that their "largest washing machine washes 80 pounds of laundry at one time. It uses 67 gallons of water to do this. To wash 80 pounds of laundry at home, it would require eight loads in the standard washing machine you would find in a typical suburban garage, and this would use approximately 350 gallons of water." The Environmental Protection Agency reported that an average household's leaks typically reach almost 10,000 gallons of water each year which ends up wasted. About 10% of homes have leaks, wasting 90 gallons or more each day. Chris and Sean Macauley, owners of American Leak Detection, said that since the drought, their calls have gone up 20%. McLean and Williams, a well specialist company, said that their calls are up 60% but they do not have the resources to fulfill all their orders since it takes so much specialized equipment and manpower.

Government Money. According to "California's Water Supply Strategy" written by the California Government and published in August 2022, "over the last three years, state leaders have earmarked more than $8 billion to modernize water infrastructure and management". The budget of 2022-2023 alone gained an addition $2.8 billion for drought relief for "hard-hit communities, water conservation, environmental protection for fish and wildlife, and long-term projects to permanently strengthen drought resilience" (California Water Supply Strategy). Over the last 5 years, the California State Water Board has invested $1.8 billion into recycled water projects. Since groundwater is being depleted at such a fast rate, local agencies are developing projects to replenish groundwater. By the end of 2023, California will have invested $350 million for these projects. According to the report, "as of May, 112 California dams are rated "less than satisfactory" by State dam inspectors, and the reservoirs behind 41 of those dams cannot be filled beyond a certain level to protect public safety" so the "DWR will administer the $100 million in the 2022-2023 budget for local dam safety projects and flood management" (California Water Supply Strategy).

Even though the California government has invested so much money into drought mitigation and rehabilitation, it does not change the fact that California remains to be in a drought because of climate change and global warming. There needs to be a systematic change rather than continuously throwing money at the issue.

Points to be made:

- More about environmental justice with low-income communities
- How covid played a role in the economy
- The state's economy and more specific on where the money is being allocated to

Chapter 3: History of California Drought

As recorded in California's history, there have been 6 previous droughts which have lasted four or more years, with two of them within the past 35 years: 1928-19354 1976-1977, 1987-1992, 2001-2002, 2007-2009, and 2012-2016. There has been a significant amount of data and research collected from every historical period. Since drought has been so prevalent in California, a lot of helpful information can be gathered to help mitigate this current drought and will help create effective policies to put in place.

1924-1934. While it is difficult to compare past droughts to modern day droughts, because the factors and circumstances differ vastly such as population, the hydrologic factor can still very well be analyzed. The population was estimated to be around 5.7 million people. The water year in 1931 was ranked as the second driest in 113 years. The impact of the drought during this time period correlates with the Dustbowl because there was an influx of migrants to California who were looking or in need of farm jobs. The Dust Bowl brought around dust storms that heavily affected the agriculture in California. Because the state's population had greatly increased during this time, the economic conditions and labor market conditions were at an all-time low. The "California's Most Significant Droughts: Comparing Historical and Recent Conditions" stresses that it is rather "difficult to compare to modern times due to the great difference in the scale of irrigated agriculture and in crop market conditions" (CDWR 2015, 43). However, the drought during this time period many large-scale water projects were in development. "The first barrel of the Los Angeles Aqueduct was completed well before the drought; construction of the Mokelumne River Aqueduct serving the East Bay was just completed at the drought's beginning. San Francisco had purchased the privately held Spring Valley Water Company in 1930 and subsequently completed construction of the Hetch Hetchy

Aqueduct in 1934" (CDWR , 41). Construction of these projects provided many jobs for the public that were needed during the Great Depression. The USDA also had emergency drought relief programs at the time for ranchers whose farmers were affected by the lack of irrigation. During this drought, there was a water war at Lake Tahoe where lakeshore property owners on the California side had issues with those who lived downstream, mainly in Nevada. This also caused salinity levels to heavily increase in the Delta because there was a lack of water management infrastructure to regulate streamflow. Many researchers have been saying the current drought in 2022 is the driest California has been since 1924. This drought is marked as the driest period in California history and was the first major drought on record for this state. This served as the blueprint for reservoir operations for the future of California's water supplies and mitigating the shortage.

1976-1977 Wake Up Call. During this two-year period, the drought was considered to have very negative impacts that were experienced because no one was prepared for these conditions. Before the drought occurred, water was relatively available in California. In most areas of California, the water supplies were lacking so reservoir storage was greatly depleted. On October 1, 1976, the average storage of the reservoirs was at 57% and a year later it had dropped down to 37%. The population during this time was around 22 million people, a lot more than the previous drought. Rural communities were feeling a lot more of the impact, facing drinking water shortages, so to help aid them they were provided emergency response actions for new wells, temporary storage tanks and pipelines, interconnections, pumps and generators, and mobile treatment units. Some urbanized areas were also feeling the effects of the drought such as Marin County. Most of the communities in Marin County were limited to basic health and safety consumption levels because they only had local surface water sources.

According to the reports from the U.S. Government Accountability Office in 1977, most of the economic impacts from the drought stem from the agriculture and forestry sectors. Around 125,000 acres of croplands that were supposed to be irrigated were left idle. “The majority of the agricultural losses were ascribed to livestock production, with a geographic extent that covered most of the state. Agricultural production losses in 1977 were estimated at $566.5 million, composed of $414.5 million in livestock, $112 million in field crops, and $40 million in fruit and nut crops” (CDWR 2015, 51). Most areas in Southern California and along the coast had an adequate amount of water for agricultural purposes, however everywhere else in California was ranging from barely adequate to almost zero surface level water supplies. “In the Central Valley, surface storage was only 47 percent of normal. In the Sacramento Valley, it was 45 percent, and in the San Joaquin, it was 53 percent” (CDWR 2015, 26). Areas that are dependent on ground water for irrigation found waters at an all-time low which did not result in less crop acreage but rather resulted in an increase cost for pumping energy. Just in the San Joaquin Valley, it was estimated that the increase in cost would be $5,000,000 for farm operators. The greatest negative economic impact from the 1977 drought was in the agriculture sector but for well drillers, they got the benefits from this because they were receiving so many work orders. It was estimated the 5,900 jobs in agriculture would be lost that year because of the drought. Those who were affected the most were farm workers focusing on soil preparation, cultivation, and harvesting field crops and vegetables. “The hardest hit of the agricultural water users [were] the ranchers and dairymen. The Department of Food and Agriculture estimate[d] that $500 million could be lost in the livestock industry” (CDWR 2015, 52). They were forced to sell a large portion of their herds at a reduced price. The entirety of California, except for regions south of the Tehachapis and desert were experiencing moderate to severe impacts to their fish and wildlife. Because

rivers were experiencing reduced flows and increased temperatures, anadromous fish, those that swim upstream, were targeted. There was also a lack of run-off the was reaching streams and reservoirs therefore the amount of nutrients for the game fish food chain was very limited.

At the beginning of 1976, reservoirs were still full, so power utilities were taking advantage of this and used their reservoirs to generate power. However, this led to creating levels a lot lower than normal. In 1977, the energy generated could not go at the same rate so the energy that was generated per unit of water had to be reduced. Typically, the hydroelectric output in a year is about 32.6 billion Kwh however in 1977 it fell short by about 20 billion Kwh. Aside from hydroelectricity, there was an increase in agricultural pumping which used an extra 1 billion Kwh of energy costing $25,000,000.

The lack of precipitation during these years lead to a severe loss in moisture for brush and timber areas in California. This led to an increase in wildland fire risk and an increased loss in trees to insects and disease. Logs, tree limbs, and stumps are large catalysts for fires and while usually buried in snow during the winter, they were exposed and dry during the 1976 and 1977 winter months. This causes fires to grow larger and burn faster reducing the ability to control it. Aside from the fact that the fire risk was higher, firefighters face another issue, not having enough water supply to combat the fires. They had to adapt to ‘dry’ firefighting methods such as using bulldozers. Many trees of all species and in all elevations are expected to die because of the drought.

A very major outcome from this drought were the state-policies that were enacted for urban water conservation and rationing. There was “a major state-level policy drive for urban water conservation, beginning the latter part of 1976” (CDWR 2015, 51). Because of these mandates, many communities were able to substantially cut back on their water usage by 50% or

more, especially those who experienced chronic water shortages and were really feeling the effects of the drought. Rural areas got loans or emergency response actions from state assistance to help ease the effects of the drought. They provided support for "new wells, temporary storage tanks, temporary pipelines, interconnections, pumps and generators, and mobile treatment units" (CDWR 2015, 51). A drought emergency task force was also established in 1977 by the Governor and out of many of the legislative proposals, about one-third of them were enacted as law. Some of them were:

- "Authorization of a loan program for emergency water supply facilities
- Authorization of funds for temporary emergency barriers in the Delta
- Prohibition of public agencies' use of potable water to irrigate greenbelt areas if SWRCB found that recycled water was available
- Authorization for water retailers to adopt conservation plans
- Addition of drought to the definition of emergency in the California Emergency Services Act" (CDWR 2015, 53).

1987-1992. The previous droughts were not comparable to the most recent droughts because it was not during modern times. This 6-year drought is the first drought that can compared to the modern level of water development. During this period, the population was about 30 million, a lot closer to present numbers. Because California was more prepared for this drought, it was not until the third or fourth year when they began to experience water shortages because they were able to get deliveries from reservoir storage. Conditions of the reservoirs did not go back to average until 1994.

The city that felt the largest effects of the drought with reservoir shortages was San Francisco because in 1991 they only had about 25% of storage remaining. This led to two turnouts being constructed on the California Aqueduct for access to water transfer. The governor declared Santa Barbara to be in a state of emergency in 1990 because they had the largest water supply reductions. The emergency measures that were adopted were so extreme, to a point where residents were not allowed to water their lawn for 14 months.

Like previous drought periods, rural areas were greatly affected because their small water systems were unreliable. Private residential wells were dried up, so some people constructed "temporary pipelines to new surface water sources" (CDWR 2015, 56). The agriculture sector was also heavily affected, with 500,000 acres being idled. Financial problems in these areas occurred because revenues decreased from water sales with an ongoing fixed water cost. In 1990 and estimated amount of $220 million was lost in gross revenue from farms and in 1991 it was $250 million. "The hardest hit commodities were grains, non-irrigated hay, and beef cattle" (CDWR 2015, 56).

In Kern Country, the Monterey amendments were enacted to balance water allocation between urban and agriculture areas. "When executed in 1994 the Monterey amendments provided that an equal annual allocation would be made to urban and agricultural contractors" (CDWR 2015, 56). A few legislations enacted during this period were:

- "Use of potable water for specified non-potable purposes was declared to be a waste or unreasonable use of water if suitable, cost-effective reclaimed water supplies were available
- A statewide goal of recycling 1 MAF of water by 2010 was set

- Existing requirements for urban water management plants were amended to require that water suppliers estimate available supplies at the end of one, two, and three years, and develop contingency plans for shortages of up to 50 percent" (CDWR 2015, 57).

2012-2016. The drought during this time was one of the longest and warmest historical droughts. The areas that were most impacted were agriculture, hydropower, groundwater supplies, and recreation. There was a 30% reduction of surface water available for agriculture across the state, so to replace the water that was loss, two-thirds of it were replaced by ground water pumping which costed an addition $600 million each year. The other 10% shortage was accounted for by idling croplands which was about half a million acres. From 2014-2016 about $3.8 billion was loss statewide just from agriculture. One of the largest negative impacts that this drought has had was the death of 102 million trees in forests alone because of the reduction of soil moisture. This was due to low precipitation and snowpack along with high temperatures. Many of the trees that did not die were left drier and weaker which lead to a higher risk of disease and infestations. The dead trees in the forests lead to wildfires and erosion. Because of the high fire risk, wildfire season last year-round during this time left water supply infrastructures at risk. This was due to low precipitation and snowpack as well as higher temperatures causing more water to evaporate. From 2014-2015, the worst years of the drought, hydropower production decreased by over 50%. It went from accounting for 13% of California's electricity to 5%. A lot of outdoor recreation that relies on snowfall or water were also suffering from the drought, such as the skiing or snowboarding industry.

Because this was not California's first drought, they were more prepared than previous droughts that have occurred. Based on past droughts, Californians know how susceptible their

state is to drought do to the arid climate and global warming. They can take preventative measure before drought even occurs. Their history of drought "has led to the accumulation of infrastructure, institutions, and changes in water demands adapted to drought" (Pisani 1984; Lund 2016c). Historical droughts emphasized how much the agriculture in California relies heavily on groundwater during dry periods so there is legislation to have better and more effect groundwater management. Governor Gavin Newsom asked State agencies to create a water resilience portfolio for the 2012-2016 drought in 2019. It heavily emphasized that regions need to work with stakeholders to work on a drought contingency plan for future droughts to help communities as well as the environment. It is important to invest in major regional interconnections for facilitating water transfers and supporting disaster preparedness. From previous droughts, California has learned how crucial it is to have dedicated storage for emergencies especially in areas where local reservoir storage is minimal. The Safe and Affordable Drinking Water act of 2019 was also enacted which is supposed to help some communities gain access to clean drinking water in the next drought. It was revealed during the 2012-2016 drought that fish and wildlife managers were unprepared or did not have the resources to manage the drought so developing plans for watersheds could help them in making sure inflow is sustainable and to maintain water temperatures. It was also learned that State hatcheries and wildlife refuges need to modernize their infrastructure because it the past drought they had to dig into their emergency funds just to keep fish alive.

Historical Comparisons. All of the historic droughts have many common factors. Small water systems are particularly vulnerable to drought because they are dependent on unreliable water sources and have limited financial resources. However, larger urban water agencies have

better preparation and drought response because they are interconnected make water transfers easier. “Three important gaps stand out in the historical experience, the ability to characterize statewide groundwater conditions, to predict if the next season will be wet or dry, and to improve drought preparedness for small water systems” (CDWR 2015, 75). One sector that is continuously and inevitably affected by the drought is agriculture, leading to farmers suffering financial hardships. As technology advances, the government has better resources to respond better to drought however, the droughts are also continuously getting worse because of the rate of climate change and global warming. A lor of government resources are also going into the drought and the water infrastructure but again, it needs to because the conditions are worsening and technology is become more expensive.

Chapter 4: *The Politics and Media Behind the Drought*

The relationship between the government and media plays a large role in combatting and mitigating the drought. The government does internal work, creating policies. However, they also take advantage of media as a bridge to spread awareness to the public through many outlets such as highway signs, newspapers, brochures, and social media. This allows the government to reach a broader audience and grasp people’s attentions through many different channels to keep pushing the need to conserve water.

The Sustainable Groundwater Management Act. Local agencies hold responsibility over the sustainability of their groundwater basins, but the state agencies must ensure that local agencies reach SGMA’s targets. A single local agency or a collaboration of multiple agencies, which may consist of water districts, counties, irrigation districts, and cities, can form a

groundwater sustainability agency. “SGMA requires local agencies to form groundwater sustainability agencies (GSAs) for the high and medium priority basins. Gas develop and implement groundwater sustainability plans (GSPs) to avoid undesirable results and mitigate overdraft within 20 years” (CDWR 2022). This was put forward by previous California governor Jerry Brown and he emphasized that “groundwater management in California is best accomplished locally”. This act requires local agencies to form groundwater sustainability agencies, making sure that there will be no overdraft within 20 years. This act ensures that there will still be high water quality, minimum surface water and ground water depletion, and minimum seawater intrusion. The California Department of Water Resources (DWR) is the main overseer that is responsible for assessing and evaluating the GSPs to make sure they in compliance with the SGMA. They also aid in helping them develop GSPs through “assistance and engagement, including facilitation support and written translation; by providing access to a variety of data and tools including data libraries and dataset viewers; and providing financial assistance through their Sustainable Groundwater Management Grant Program” (waterboards.ca.gov). Around 300 GSAs have already been formed and the SGMA gives them tools to help them manage groundwater to meet the targets of their plans.

2018 Water Conservation Legislation. This legislation enacted in 2018 had 4 primary goals, use water wisely, eliminate water waste, strengthen local drought resilience, and improve efficiency of agricultural water use and drought planning. The 2018 Water Conservation Legislation was enacted for both urban and agriculture sectors. To implement this the Department of Water Resources (DWR) and the State Water Board prepared a primer to summarize the legislation for the public, “Making Water Conservation A California Way of

Life". The Water Conservation Legislation made important changes to both urban and agricultural water management planning and wanted to enhance drought preparedness in all communities. This affects residents of California because the legislation is developing new standards for both indoor and outdoor residential water use. It will also develop new standards for all types of landscape irrigation with dedicated meters. There are annual water budgets that urban suppliers must stay within, and they will need to provide a report on their new measures for commercial, industrial, and institutional use. The CDWR states that "the legislation also made important changes to existing urban and agricultural water management planning, and enhanced drought preparedness and water shortage contingency planning for both urban water suppliers, and small water systems and rural communities".

Model Water Efficient Landscape Ordinance (MWELO). This act was developed in 1993 but was updated in 2015, at the height of the past drought. Half of the urban water that is produced in California goes to landscape irrigation. However, with efficient landscape design, installation, management, and maintenance, water usage can be reduced and saved. This may be achieved by choosing climate adapted plants, improving soil conditions, having higher efficiency irrigation, and managing irrigation schedules. Some cities have mandates of allowing residents to water their lawns with sprinklers two or three times a week. "All local agencies must adopt, implement, and enforce the MWELO or a local Water Efficient Landscape Ordinance (WELO) that is at least as effective as the MWELO" (CDWR 2022). MWELO states the purpose for this model ordinance is to:

1. "Promote the values and benefits of landscaping practices that integrate and go beyond the conservation and efficient use of water"

2. Foster a collaboration between industry, government, and property owners when installing water efficient landscapes
3. Establish guidelines for water management practices as well as water waste for already existing landscapes
4. Establish a Maximum Applied Water Allowance to prevent water waste
5. "Promote the benefits of consistent landscape ordinances with neighboring local and regional agencies"
6. Have local agencies and water purveyors implement financial incentives to promote the efficient water usage
7. Have local agencies establish authority to enforce MWELO

Not only is this ordinance trying to increase water efficiency, but it is also trying to improve the conditions of the built environment beyond the aesthetics of it. It will also decrease the need of harmful fertilizer and pesticides.

Assembly Bill No. 1668. There were two main purposes this law wanted to serve. One, identifying "small suppliers and rural communities at risk of drought and water shortage vulnerability" and two, developing "recommendations for improving drought contingency planning for those areas" (CDWR 2022). Since this bill was passed, the Department of Water Resources created recommendations that aided small water supplies and rural areas to meet their drought planning needs. The bill wants to implement drought-tolerant plants wherever it is feasible and focus on native plant species. It also wants to promote the replacement of irrigation timers for a more efficient watering schedule and replace these irrigation systems with drip

irrigation, bubblers, or low precipitation spray nozzles. Assembly Bill No. 1668 wants to emphasize the use of recycled water or rainwater for irrigation.

Racial Equity. The California State Water Resources Control Board established a Racial Equity Action Plan for 2023 to 2025. Their first strategic direction is to integrate racial equity through the Water Board's policies and measure impact. The first goal is to make sure that the Water Board's data is accessible, equitable, and culturally relevant. The Safe and Affordable Funding for Equity and Resilience drinking water program collects and analyzes demographic data in the Needs Assessment and Fund Expenditure Plan which determines where funding gets allocated to. The Water Board is also in the process of developing maps to highlight and prioritize disadvantaged communities. While they are making good progress towards their goals, there are still improvements that need to be made. They need to gather more data for more emphasis on the disparities in programs and policies regarding racial equity and environmental justice. They also need to train their staff to conduct better analyses through a racial equity lens and need a better understand of the demographic. The Water Board needs to collaborate with the BIPOC communities to gather their insight and to create a just framework which leads into their second goal. The Racial Equity Action Plan states that "programs and policies are evaluated and realigned to address racial injustices". They understand that racism has played a whole in creating a gap where there are systemic inequalities in the "affordability, access, allocation, and protection of water resources" (Water Board). Some programs have already been modified for example, tribal beneficials have protected water use in State Water Board and Regional Water Board basin plans.

The Water Board's second strategic direction is to create and maintain a space for inclusion. The first goal is to bring on staff and leadership that would reflect the diversity of California. With a diverse board, they could get a broader perspective, more innovation, and more relatability to create personal relationships with the communities the Water Board serves. To make sure they achieve this goal they "require hiring panels to have expertise on implicit bias or rachial equity, include a diversity statement in job advertisements, establish model diversity interview questions, and target recruitment efforts" (Water Board). They are still progressing towards this, as 37% of California's population is white but the Water Boards' workforce is 57% white. Their second goal for their strategic direction, to create a place of inclusion is being taken underway.

Their third strategic direction is to activate BIPOC's community wisdom and to share power. The first goal is to "engage with BIPOC communities by providing effective language access services and accessible communications" (Water Board). There are over 200 spoken languages in California and the U.S. Census Bureau reported that about 44% of Californians speak a language other than English in their household. Sometimes the information conveyed by the Water Board is too complex and technical to reach and resonate with the communities they are targeting. In 2021, the Water Board provided 448 documents that were translated in 13 different languages and 60 oral interpretations were provided. The second goal is to "remove barriers for community access and participation in water decision making by providing resources for capacity building, including funding, training, and education" (Water Board). This will allow for equitable community representation and participation. Some of these barriers include language, technical jargon, lack of technology access, and a lot more. The last goal mentioned in this report is the partnership with BIPOC communities. The community themselves know what

they need and what their strengths are. So if the Water Board receives feedback from them, they can better understand what they can help with.

Student Education. The DWR wants to educate all Californians despite the age, about everything regarding water, from where it comes from to how to conserve it. They provide free supplementary materials for educators to implement in their curriculum at elementary to high schools. These consist of worksheets, activity books, posters, videos, and curriculum guides. Many students respond better to hands-on and visual learning, rather than just listening. The materials the DWR offers are engaging and are designed to capture students' attentions so they can grasp the information.

Governor Newsom's Plans. Governor Newsom has been creating plans and policies to help mitigate the drought. He says that "with a drier landscape become the norm, we're stepping up to help Californians replace their lawns with drought-tolerant landscaping that will help us combat the drought we're in and build resilience for the future. Conservation is just one part of our strategy – that's why we're finding ways to stretch the water supply we have, create new sources of water, and increase storage. It will take all of us working together to weather this drought and save our water". As one of Newsom's strategies, legislation AB 2142 was enacted which exempts turf replacement rebates on resident's homes from state income tax. The strategy behind this law is to incentivize Californians to switch to drought-tolerant landscaping which will not only conserve water but also ensure that they save money. For the 2023-2024 state budget, Newsom wants to propose an additional $125 million for drought mitigation. In April 21, 2021 Governor Newsom proclaimed a state of emergency in the Klamath River, Sacramento-San

Joaquin Delta, and Tulare Lake Watershed Counties. One of the orders of the Proclamation states that "to support voluntary approaches where hydrology and other conditions allow, the Department of Water Resources and the State Resources Control Board (Water Board) shall expeditiously consider requests to move water, where appropriate, to areas of need, including requests involving voluntary water transfers, forbearance agreements, water exchanges, or other means" (Newsom). Newsome understands the urgency of the drought is going through extreme measures to mitigate severely dry areas. These areas are of high priority for drought and preparation resources. Many state departments are involved with this including, the DWR, the Water Board, the Department of Fish and Wildlife, and the Department of Food and Agriculture, where the will all consult with the Department of Finance. Their responsibilities consist of: "a. Accelerate funding for water supply enhancement, water conservation, or species conservation projects. b. Identify unspent funds that can be repurposed to enable projects to address drought impacts to people, ecosystems, and economic activities. c. Recommend additional financial support for groundwater substitution pumping to support Pacific flyway habitat needs in the lower Sacramento River and Feather River portions of the Central Valley in the Fall of 2021" (Newsom).

Government and Media Collaboration. Caltrans, otherwise known as the California Department of Transportation, uses the highway transportation system and associated facilities to promote and implement water conservation strategies. "Cost effect and appropriate water conservation strategies are employed in the design, construction, operation, and maintenance of transportation facilities including water conserving irrigation systems for highway planting and to the maximum extent practicable, the use of recycled water" (CA.gov

2022). The Department of Water Resources is currently partnering with Caltrans to promote conserving water on highways all around California. They have electronic signs that read "SEVERE DROUGHT. SAVE WATER. SAVE CALIFORNIA." and "SEVERE DROUGHT. LIMIT OUTDOOR WATERING". It is so specific to outdoor watering because it constitutes for up to 60% of the average water use of California residents. The signs on highways started in 2014 and are still in use in 2022. The more that Californians are reminded that the state is still in severe drought, the more conscious they will be about their water usage. The government is attempting to spread drought awareness through media practices. In some regions, Californian's also get a monthly water report that reveals how much water they have used in a month compared to other nearby households with the same family size. When people receive a physical, tangible report to see how much water they have used, they are likely to respond well. It also gives them a healthy competition with other household's mentioned in the report to conserve more water.

The Save Our Water campaign is a water conservation program that was created by the Association of California Water Agencies and the California Department of Water Resources in 2009. Each year millions of California residents are impacted by the program because they partner with local water agencies and community-based organizations. They government is collaborating with multimedia platforms to spread awareness though social media and event sponsorships. This campaign is focused around encouraging and educating California residents to reduce their water usage as the drought continues to worsen. On the week of April 14, 2022, the campaign had created "new content across various multimedia platforms including social, digital and streaming platforms, out-of-home, and radio" (CA.gov 2022). Because California is so diverse in culture, there are also multilingual ads that were published including Spanish,

Cantonese, Mandarin, Vietnamese, etc. On the 14th as well, California had a briefing with Governor Newsom and over a dozen social media influencers and content creators such as Nash and Hayes Grier, because the government wanted their support on statewide education efforts. They want to use these social media stars to help influence their followers to save water. "The Save Our Water campaign aims to create a broader and long-term culture of water conservation and highlights the urgency for Californians to take important steps to save water. From everyday actions like watering less outdoors to switching to low-water plants, there are simple steps we can all take," says Wade Crowfoot, the California Secretary for Natural Resources. The Save Our Water campaign was enhanced because of the additional state funding that was allocated in March it was used to help encourage residents to conserve more water at home. It highlights the urgency and severity of the drought, and they are making some changes to homes and yards with smart water systems, offering the most impactful ways to save water. Water conservation is the best method to combat the ongoing drought even though the state has made a large sum of investments in tools and technologies. The Save Our Water Campaign has also created urgency ads to place in convenience and grocery stores. In many public bathrooms, there are signs that urge users to limit and be conscious of their water use. There are many signs in front of businesses to encourage customers to limit their water use. For example, Quick Quack Car Wash, California's largest car wash chain, has signs in the front stating "This car wash uses recycled water, helps save up to 85 gallons per wash". It also encourages customers to only wash their car when absolutely needed.

News Media. A very important factor in mitigating the California drought is news media. Water savings is linked to public education and awareness, especially when people are made

aware of the long-term consequences and effects. When the California drought took place in 2011, it was noticeable that residents were starting to cut back on their water usage even before there was a mandatory conservation that was ordered by local water agencies and the California government. Newsha Ajami, the director of Urban Water Policy at Stanford conducted a study, published in Science Advances, to find the link between media and household water conservation. One thing they discovered in their research was that the more that people read about the drought and were more educated, the more water they conserved. As their interest grew in reading about drought grew, the more the media covered, which created a positive feedback loop. "We found an increase of 100 drought-related articles in a bi-monthly period was leading to about an 11-18 percent drop in water use for single-family residential. And that was pretty significant" (Ajami 2017), Ajami mentioned in an interview with Water Deeply. In her studies they followed Google Trends for 'water conservations' and 'California drought' to figure out if there was a connection between those two. Ajami said, "you would see media coverage go up on "California drought" and water use would drop. And the media was responding to public interest". After media coverage increased, residential water use decreased at a fast rate. One key point is that many people do not go out of their way to read scientific or journal articles, they only read what is handed to them. "Before this drought, a lot more people didn't know how their water system works" (Ajami 2017). Not only does the media have to convey their message in an intelligent manner but it also must be captivating and easily interactable. It was revealed that high-income people did not respond to media as much as lower- and medium-income communities and Ajami speculates that the reason for this was because higher income communities "hire landscapers and basically outsource some of their outdoor water use". In Ajami's research article, "Changes in water consumption linked to heavy news media coverage

of extreme climatic events", she reported that news media coverage of the most recent historic drought was very high from 2012-2015. Her study showed that "news media coverage was correlated with changes in urban water use in the San Francisco Bay Area from 2005 to 2015". The knowledge that consumers use less water after public awareness can help water managers convey their messages better through more captivating conservation campaigns and education. The more knowledge the consumer gains, the more connected they feel to their water use where they are more likely to change their behavior. The most read and popular online news websites publish countless articles on the effects of the drought to convey the severity of the drought. Many of the articles that were being published talked about everything behind the drought, from where water was coming from to the importance of snowpacks and reservoirs. Because of this, the readers were a lot more educated with such valuable knowledge that they did not know of before they read about it in the media.

Chapter 5: *Policy Recommendations*

Tying all the previous chapters together, with all the data and research, I will be providing some policy recommendations that could help California in mitigating and reducing the effects of the drought. There are already so many policies in place in trying to aid California during this time however, there is still so much that can be done since the drought is so persistent and seems like it continuing to worsen. Each sector such as agriculture, media, and public education, can always use more policies in place to help develop their methods in dealing with the drought. These policies will require the government, businesses, and residents to all collaborate. If these policies are enacted, it will not only help California in its current state with the drought, but it can also help prevent future droughts by taking preventative measures.

Policies are essential for keeping Californians accountable for their actions as well as state members.

Leaning From the Past. In the April 2022 PPIC report, they list a variety of policy changes that could aid California farms amidst the drought. One mentioned was to address the negative impacts of increased pumping which would spread awareness. “To avoid impacts like dry wells and subsidence, a combination of local pumping restrictions and mitigation plans will likely yield the best outcomes” (PPIC). For example, local ground water agencies could provide an incentive for farmer to avoid pumping in areas where there would be major impacts. The government could also provide funding for alternative solutions that would allow farmers to continue using groundwater and support their economic activity. Another policy change that was brought up is to accelerate demand management, organize trading, and repurpose land. Newsom should act fast to implement this policy. As the population continues to increase, there will only be an increase in demand for water but not enough supply to meet these needs. The last policy change that the PPIC report mentions is improving water storage by getting more water into the ground so that the basins can be recharged. The government needs to continue to work heavily with water engineers and contractors to create a system where basins can be recharged at a faster pace. Even when California is not in a state of drought, residence should still be urged to keep conserving water because climate change will only get worse. Water consumption will only increase as the population increases. The atmosphere of California will always be dry, always leaving the state vulnerable to drought.

Environmental Justice. As previously mentioned, Governor Newsom vetoed a legislation that would require all community water and wastewater systems to aid residential water consumers because he did not think that there would be enough funding for it. Despite this being an issue with drought, it also brings up the topic of environmental racism and environmental justice. Passing this legislation would be very important to society not only because will it provide water to all those who need it, which is something that everyone should have a right to, but it will also narrow the disparity between high-income and low-income communities. The government can implement a policy where they create a system with other states with abundant reservoirs to facilitate water transfers when necessary. As of right now, low-income communities must sacrifice money they have set aside for clothes, food, and other necessities just so that they can have access to clean water. It is unfair that low-income communities are greatly feeling the effects of the drought because of where they are placed and where they can afford to live. There needs to be a policy implemented that ensures that low-income communities receive the same amount of water and of the same quality as residents that can afford it. There needs to be a legislation enacted where low-income communities are required to pay less for clean, safe water or tax higher-income communities more for their water to ensure that they do not overuse resources. As the Water Board is in the process of creating a Racial Equity Action Plan, implementing their policies listed would be of great importance. The most important factor is to understand the needs of these communities by directly communicating with them. Low-income communities should be involved in the policy change process because they know best what would benefit them.

Climate Change. As mentioned in Chapter 1, the drought is the result of climate change. A large part of climate change is due to greenhouse gas emissions. This comes from large corporations and those who can afford to use a large amount of energy. Because of this, low-income communities are feeling the effects of it even though they are not the biggest contributors of greenhouse gas emissions. This has been a large issue for a while, not just in California but in the entire world. This is greater than the state government and there needs to be a worldwide declaration of emergency to ease the effects of climate change if that is even feasible. The drought in California is just evidence that climate change and global warming is real, and people of higher power need to start taking action to slow down or even reverse the effects of it. There could be a policy enacted that would increase energy bills on nonrenewable resources. Fines should also be more heavily enforced on greenhouse gas emissions which would not only reduce the emissions but could also improve the economy. There needs to be a stricter cap-and-trade system that ties back to drought. The focus of a cap-and-trade system is greenhouse gas emissions but if there is a focus on the drought as well, it could be more effective. For example, the government could issue a water cap and issue a quantity of a set amount of water.

Agriculture. Since California is the largest producer of agriculture in the United States, a lot of aid should be going to farmers in the state. Many of them are suffering because of the lack of water and are not making enough income to bring home to their families. There should be a policy implemented that would provide funds and compensation to those farmers who cannot afford to grow their crops anymore because the cost of water is too high or there is a lack of irrigation water. The USDA is providing some aid to farmers unable to produce crops for the year, but it does not solve the lack of water for crops. If they cannot produce enough crops, they

should be provided with a backup plan until conditions revert to normal. Farmers should be getting paid higher prices for the crops that they grow without increasing the price of groceries in stores. Agriculture is their main source of income and livelihood so the government should provide some sort of compensation for them. So many of them are placed out of jobs and are struggling to find some in this economy. A lot of the policy making should be turned to the agriculture sector, since they are the main factor of the declining California economy due to the drought.

Since California is the agricultural hub for many different crops that people consume, people all over the country are contributing to the drought by purchasing and demanding these products. To address this issue, the state government needs to work with the nation to slow down the demand for water thirsty crops such as almonds and avocados. The government should also work alongside farmers and incentivize them to produce more drought resistant crops with rebates or subsidies. This also goes beyond just the state of California. Consumers of California-grown products also need to be aware of the drought and be more cautious when consuming these products.

Public Education. California should also take some preventative measures for the next drought to reduce the severity of it. It all starts with climate change. As the land becomes warmer and drier, water levels continue to decrease. One policy that should be implemented is educating the public more about the causes of drought and the background behind it. Residents of California play a large role in mitigating the drought, since they are one of the main water users. By realizing the severity of the drought and what's causing it, they can make a difference by reducing their water consumption even more. There is already evidence and statistics that reveal

that the more that the public is educated and aware, the more their water consumption decreases. Especially since it's going to be the younger generation who's going to be feeling most of the negative consequences of the drought in the future, the government should create educational media to appeal to them. The Save Our Water Campaign's efforts, mentioned in the previous chapter, of using influencers to help spread awareness was a great start but unfortunately so many more social media creators need to be doing more to spread their message around, especially if they claim to be influencers. This policy builds on The Save Our Water Campaign because there are visible positive results from this. The Save Our Water Campaign is doing a great job in keeping up with updates, but the drought is not improving and there is always more that can be done. The campaign could do more with social media influencers, as they are starting to do. They could reach out to the most popular content creators and celebrities and have them encourage their followers by setting a good example of why it is so important and beneficial to conserve water. The education sector should also require students to learn about the drought and implement it in their educational curriculum. As of right now, there is no enforcement for educators to teach students about the state of California and its water sector. School can also create engaging, fun clubs and encourage students to join.

Media. Media also plays a large role in mitigating climate change because it is the largest mean of communication to reach people. As technology becomes more and more prevalent, it may be the key to slow down the drought. There should be a policy put into legislation to use more media resources, whether it be news outlets, social media apps, or billboards to convey the message to the public to conserve their water. Many news websites and mediums are losing their popularity due to the rise of social media. The state government should allocate money to non-

profits that are focused on water conservation and the state of the environment to use their platform to advertise and promote water conservation. As users scroll through TikTok, their For You Page gives them targeted ads through the algorithm so accounts promoting water usage can use the algorithm to target users in California.

Because high-income households do not care as much because they can afford to have clean, unlimited water, they should pay an increased fine if they exceed their water usage limit. Many high-income residents are aware that California's drought is creating a state of emergency but are either ignorant or choosing to ignore the messages. As previously mentioned, the water reports have been helpful to track water usage from household to household and gives families an idea of how much water they have been using. Policies like this, that spread awareness to residents instead of keeping them ignorant to the drought are so helpful because they are being constantly reminded of the state of emergency that California is in. These reports are also helpful in "guilting" residents by comparing them to their neighbors and showing who is doing their part to conserve water and who isn't.

Design. One policy, thinking outside the box, is using floodwaters to mitigate the drought. According to an article written from Stanford University in *Science News,* "Using floodwaters to weather droughts", it states "using a new computer framework, scientists are able to project future floodwaters under a changing climate. The approach could help California water managers plan to redirect floodwaters toward groundwater aquifers, alleviating both flood and drought risks." Because of climate change and global warming, there have been more natural disasters including floods. Most of California's infrastructure is not constructed to sustain floods so stowing away floodwaters would reduce flood risks as well and build water reserves. The

process known as water banking "involves augmenting surface infrastructure, such as reservoirs or pipelines, with underground infrastructure, such as aquifers and wells, to increase the transfer of floodwater for storage in groundwater basins" (Stanford University). While this may not be the most feasible solution for California's government due to all the structural changes they have to make and the cost, it will keep the environment sustainable not only because there will be more groundwater stored but it would also prevent flooding. New technological invention would not be needed either because it is just a matter of augmenting the structure of surface and underground infrastructure. According to the article, even though "groundwater basins offer a vast network for water safekeeping, pinpointing areas prime for replenishment, gauging infrastructure needed and the amount of water available remains key, especially in a warming and uncertain climate" (Stanford University). Even though there aren't any floods in California coming soon, this is a good policy to implement to combat future droughts and during this dry period, the infrastructure can start being augmented.

Incentives. People respond to money. Currently, the government is funding numerous infrastructure projects to help repair the damages of the drought. However, funding should go to methods to slow down the rate of the drought and it starts with California residents. The government can incentivize residents to implement more water conserving products in their household. If the state of the drought worsens, the government can even start giving away these products rather than having people buy them. The government can also incentivize residents indirectly. They could provide funding to private water and utility companies. These companies could discount their new products or provide rebates for water-efficient appliances.

There is no way to be certain that California will never be in a drought again, nonetheless, in a state of emergency due to the consequences of the warming climate. However, as the state and the federal government focus more of their attention on California's water conditions, the effects may not be as severe. Everyone that inhabits California plays a role in the drought, but they also have the power to ensure that they can reduce the effects by their relationship with water.

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