

Water Whiplash

<https://www.climateone.org/audio/water-whiplash>

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Announcer: This is Climate One, changing the conversation about energy, economy and the environment.

Over the past few years, many parts of the country have experienced record drought - followed by epic floods. You could call it "water whiplash."

Barton Thompson: *So this is always been normal, but with climate change, what's gonna happen is those juxtapositions of floods and droughts are going to get even worse. We're gonna see them even more and the conditions at both extremes are gonna be worse.*

Announcer: California has seen five years of severe drought - followed by a deluge of rain this past winter. With all that instability, how do we stabilize our water supply?

Felicia Marcus: *Whether it's the drought, or now these rains, we get reminded all the time of the need to prepare, prepare, prepare and the need to deal with our infrastructure. Not just new infrastructure, but our old infrastructure. It may not be that sexy, but it's incredibly important.*

Announcer: The perils of water whiplash - up next on Climate One.

Announcer: Extreme droughts and floods are happening more frequently, wreaking havoc on our water supply. How do we deal with this water whiplash?

Welcome to Climate One - changing the conversation about America's energy, economy and

environment. Climate One conversations - with oil companies and environmentalists, Republicans and Democrats - are recorded before a live audience and hosted by Greg Dalton.

Today on the program, we discuss the challenges of having too little water - and of having too much. Greg is joined by Buzz Thompson, former Director of the Woods Institute for the Environment at Stanford and a professor of natural resources at Stanford Law School. Felicia Marcus is chair of the California Water Board and served at the EPA under President Clinton. Don Cameron is manager of Terranova Ranch in California Central Valley where he farms a variety of fruits, vegetables and nuts.

Here's our conversation about living with water whiplash.

Greg Dalton: Buzz Thompson, let's begin with you. There was always droughts and floods and put us in historical perspective, this recent historic drought in California and then this massive rain that we had this last year. How unusual is that historically?

Barton Thompson: Yeah, so that's a great question. The largest flood that we have probably experienced since statehood was during the winter of 1861 to 1862 when it rained so much and the temperatures increased in order to also melt the snow that we ended up with a flood in the Central Valley of California that was 300 miles long, 20 miles wide. And not only flooded the Central Valley of California, but also other portions of Northern California, the Mojave Desert, the Los Angeles region.

And yet even though we had a flood in December and January of that year, by June we were beginning what's known as the great Civil War drought, which lasted for five years and was one of the worst droughts and perhaps was even worse than the drought that we've recently experienced. So this is always been normal, but with climate change, what's gonna happen is those juxtapositions of floods and droughts are going to get even worse. We're gonna see them even more and the conditions at both extremes are gonna be worse.

Greg Dalton: Some people say the wets get wetter and the dries get drier, right. Was that right? So there are always been floods and droughts but there's gonna be bigger floods, bigger droughts.

Barton Thompson: That's true. And it's gonna be true not only in California but will be true throughout the United States.

Greg Dalton: Felicia Marcus, do we know that this is climate change? Because some people might just say, well, the weather is always changing.

Felicia Marcus: Well a number of people, I mean the question is what do we know. I mean researchers at Stanford have talked about the fact that with climate change and increased heat, droughts do get worse and they act longer. The dryness and the heat has two impacts. One is it can make the drought worse as things dry up and as they dry up and you finally get some rain it sinks into the ground rather than running off. We had to come up through the drought; we had to come up with new measures of runoff measures where because the straight precipitation wasn't telling a story about what was gonna end up in a reservoir. The other impact that it has and this is the one that scares us to death and is the, you know, Godzilla of all wake-up calls is that in California most of the people and most of the agricultural production is not where the water falls and it's not used in the time of year when it fall. So storing it not just in the wet part of the year for the dryer part of the year, but in what years for dry years require storage. And our snowpack is a third of our storage in an average year and the projections are that we're gonna lose it. And we're gonna lose it faster with just a few degrees of increased temperature.

So that's really the biggest impact that we are already starting to see. If you look at this year even in the Northern Sierra we have 200%, 209% of average precipitation, that sounds fabulous. We don't have anywhere near record snowpack. We still have a ton of snowpack and we're grateful for every flake. But if you look at those two curves between precipitation this year and the snowpack we have, they don't match.

Greg Dalton: And is that because the precipitation came as rain and not snow because of warmer temperatures, is that right?

Felicia Marcus: Exactly and that's gonna happen more in the past, which means more flooding in the spring the winter and the spring and less snowpack to tide us over and refill our reservoirs and replenish our streams and our groundwater basins throughout the spring and the summer.

Greg Dalton: Don Cameron, you're growing fruits and nuts and vegetables in the Central Valley. How is this affecting you, how is the, you know, not enough water, and then too much water, how is that affected your business growing food?

Don Cameron: You know, when we look back at the way we used to farm we use this flood irrigation for irrigation. We see a lot of water, we grew primarily three crops at that point and there was cotton, alfalfa and grain. Since then, we've moved forward and now we farm about 25 different crops. But in around 2008, 2009 we switched our method of irrigation to subsurface drip for primarily all our crops. And we've been able to cut back on our water use, we've been able to use less water and produce more crop. But what, you know, as we're looking forward we're seeing that our springs are becoming warmer, we're not getting the frosts, we're planting earlier and we're going into the shoulder season in the fall too. We're growing peppers all the way into November harvesting late November. So we're trying to take advantage of those situations to help us find better markets and be a little more diverse.

Greg Dalton: And you made that change from flooding the fields to irrigate your crops after a trip to an unusual place. Tell us the unusual place in the world where you learned, you got that technology.

Don Cameron: Actually it was on a trip to Jinjiang province in China.

Greg Dalton: Far Western China very arid area.

Don Cameron: About as far as you can get from an ocean. And saw how they were irrigating with the drip irrigation tape there it was on top of their tomato plants. It was all gravity fed, wasn't filtered. We came home and turned around, pressurized it, put a filter on it and went subsurface so we didn't have any mold issues with the tomatoes. And we reduce water consumption over 30% and actually our yield jumped from up 42 tons up to around 60 tons an acre.

Greg Dalton: Lot of farmers say, I'd like to do that; it's expensive to do it, if the state or someone will give me some money to do it. Was that economic for you to invest in that technology and why don't more farmers do that sort of thing?

Don Cameron: Well, the canning tomato industry is switched in and they're over 95% subsurface drip now. The growers watch what other growers do and they found out that it really was economical to make the change.

Greg Dalton: We're talking about water at Climate One. I want to go to - we're talking about too much water and not enough water. We wanted to hear what it's like on the front lines of a water crisis, the problem of having too much water. We spoke by phone with Terrie Tata who lives in the

town of Oroville, California. Was one of almost 200,000 people evacuated last winter after an emergency spillway from the Oroville Dam was threatening to collapse the dam, the highest in the country, it was built in 1968. And like much of the country's water infrastructure was overdue for maintenance and repairs. Let's listen.

[Start Clip]

Terrie Tata: *My name is Terrie Tata. I live in the middle of Oroville. I received a notice on my phone saying that we have 60 minutes to evacuate. It was very scary. According to my doctor I had a heart attack myself.*

We didn't know the risks because we didn't know it was the risk. And this year that it's an exceptionally wet year after so many years of being very dry. You know, anything could have happened and it did happen. Business had been lost; the majority of the people that live here are below the poverty level. So these people do not have the means to go anywhere.

Whatever they create now or they fix that's the way has to be good enough for another 50 years of this because this is an earthquake zone area. And if anything like that happens in this area, the water is gonna flow freely down south and we are going to be taken with it.

[End Clip]

Greg Dalton: That was Terrie Tata who had to evacuate her home for several days this past February for fear that a massive flood would destroy her entire town of Oroville, California. Felicia Marcus, she said she got 60 minutes to evacuate. Her doctor told her she had a heart attack. Poor people living in a vulnerable area, earthquake zone estimates are \$50 billion to fix California's water system which provides a lot of the food that ends up on tables across the country. What's gonna be done to fix Oroville and all the other creaking dams in the state?

Felicia Marcus: Well, I can't speak to what the Department of Water Resources will do at their dam. I know they're all on high alert and it was all hands on deck for Oroville where the spillway went, which was not something that they expected. I think they came together with the local emergency officials at the local level and made calls that were calls they felt they needed to make.

But I think whether it's the drought, or now these rains we get reminded all the time of the need to prepare, prepare, prepare and the need to deal with our infrastructure. Not just new infrastructure, but our old infrastructure and the new kinds of infrastructure that we can take advantage of. I think people are talking about replacing and restoring our existing infrastructure. It may not be that sexy, but it's incredibly important. And people are out there thinking about new kinds of infrastructure to deal with flood control and water storage including groundwater storage and including smaller storage. We need it, big, small of all kinds and all of it needs to be maintained, levees, floodplains, et cetera.

Greg Dalton: During that, that was national news when the Oroville Dam was kind of crumbling before our eyes. And there was some question whether the Trump administration would declare disaster people apparently who is on Twitter trying to get the president's attention. What is the federal government gonna do, does California need the federal government, the Trump administration to help fix because there's a lot of federal money in the California water.

Felicia Marcus: My understanding and I don't know the details about it. Sorry to say it's not my department so I don't know all of the details about it. But my understanding is that federal government has been helpful. Generally in disasters, and unfortunately, having run a public works

department at the local level years ago and gone through more disasters than anyone should ever have to go through. I found that in a time of disaster, everybody steps up. They really do and put aside some of their rivalries, politics, you name it. The real trick is in your earlier question is how do we invest in the future in an ongoing way. How do you maintain what's been there without having to wait for a crisis for the attention to happen. And that's something that I think I've seen renewed determination on people's parts to do. But I think it's on all of us to try and maintain that vigilance and, you know, we're gonna have to go back to the people of California and tell them what it's gonna take to invest in the kind of infrastructure we need to maintain our economic and social vitality, let alone public safety for the next 50 years.

Greg Dalton: Buzz Thompson, it's often people of lower income levels who live in floodplains mainly don't have flood insurance. Floods and droughts are some of the biggest natural disasters in terms of dollars of damage around the world. What do you see is the risk going forward if as you say there's gonna be more extreme droughts, more extreme floods. Who are the populations at risk and how can they be protected from what may be coming their way?

Barton Thompson: Yeah. So you're absolutely right that as we see more extremes, all of our infrastructure is going to be under increased pressure. So for example, with our dams, they're gonna see conditions that we have never experienced before. And if you look at all the infrastructure relevant for example, to dams, the major people who need protecting are generally gonna be the poor. So right downstream, from dams, most of the neighborhoods tend to be poor neighborhoods. Most of the people who live in the floodplains of California tend to be poor and we do not I think at this point have a particularly good system for protecting them.

For example, we have flood insurance. But flood insurance is sometimes out of the reach of some of the poorest members of our population. So about the only thing at the moment we can do is actually invest in that infrastructure in order to try to protect those populations. So we do need to invest in restoring our dams. We need to invest in ensuring that our levees are up to the task that's gonna take a lot much, lot more money than we've historically spent in this particular area.

Greg Dalton: Don Cameron, you did something unusual. Your neighbors kind of thought you're such a little crazy. You flooded your field, and can flooding farms and, you know, can that be a way to kind of direct water during floods and break a levee and kind of plan to flood fields when necessary?

Don Cameron: Right. We knew long-term that our ground water levels were declining. And in 2011, we actually took floodwater and conveyed it on to our growing crops. We had water 1 to 2 feet deep in our vineyards and we kept it on for four, four and a half months. This year we're doing the same thing, we're intentionally flooding wine grapes, almonds, pistachios, alfalfa, hay. We have one vineyard that we already put over 10 feet of water going to the groundwater. So we're looking at diverting floodwater and trying to improve our groundwater.

Greg Dalton: How does the wine taste after you flood the vineyard with 2 feet of water?

Don Cameron: Where we farm isn't Napa Valley. So it's not \$150 bottles of wine that we're producing. But by the time we get into the summer, the vines actually use the water up during that period and we have to go back to drip irrigation to get to harvest.

Greg Dalton: And but you're doing this, you know, often groundwater, as talked about as a bank account, right that you draw from it in dry years, you put it back in wet years. So you're putting water back in your own bank account. Are you worried that your neighbor next door is gonna have a straw and suck water out of your account?

Don Cameron: No, I think we're looking long-term that the region needs to build the groundwater back up. In California, we have regulations that will be addressing that in the near future. But we started way before the regulations came into place. We felt it was the right thing to do and we feel that long-term, this is gonna be good for community and for all of our neighbors. We want to bring them into the program. We have a project that's going to hopefully get up to 16,000 acres and actually put in 30,000 acre-feet a month into the groundwater.

Greg Dalton: Buzz Thompson, there's been a lot of talk about extreme extraction of groundwater in central California Central Valley. The land is actually subsiding, sinking in some areas and that's been the area of concern. So can this perhaps redress some of the sinking ground in like farmland of California putting groundwater?

Barton Thompson: It certainly can. And it would be great to see even more of this type of practice taking place. And one of the things that we need to do is to make sure there's an incentive in place and in particular to make sure that if somebody is willing to use their land to store water that that is their water so that they can take advantage of that. One of the problems that we've had, though, is that as you actually extract groundwater, in some of the groundwater aquifers you get a compaction of the aquifer itself so that you have less storage capacity in the future. So it would be great to see people at this point in time, making the step of actually trying to replenish the aquifer so that we don't lose that capacity in the future.

Greg Dalton: And how much of this is contained in California? How much of this is relevant to other parts of the United States, the Great Plains? Climate change is gonna affect the delivery of water in lots of places, Buzz Thompson, is this unique to California or is this something that could be considered in the Ogallala or other areas?

Barton Thompson: So the first thing to recognize is that the over-drafting of our groundwater aquifers where we extract more water than is naturally being replenished is not a problem that's limited to California. This is a problem that you see throughout the Western United States and in fact you see it globally. The solution of actually going in and taking surface water when it's available and storing it in that groundwater aquifer is one that is available any place that you have surface water available. In California thankfully, because we plumbed our state really well and we can move the water around fairly easily it gives us a great opportunity to engage in groundwater storage and recovery.

Other portions of the United States however, including some areas over the Ogallala Aquifer there's less surface water available even during wet periods. So there they are actually much more out of luck than California.

Greg Dalton: Felicia Marcus, the Colorado River is key to what, 40 million people or so in the Western United States. We've had a very wet year in California, how about the Colorado River, how is its health?

Felicia Marcus: Well, the Colorado has been it's been a nail biter for the past decade. They've been in a long-term drought but it is a long river through mountains that has a lot of storage on it. But getting to the point of passing a line where shortages would be called among the states, California has the good fortune of having most senior water rights holder on the Colorado even though we're at the bottom. And so we have a little bit of insulation but in the 90s the other basin states sort of called are bluff because we're actually using more than our allotment. There was a huge negotiation to cut back to the 4.4 million acre-feet that we were entitled to. Since then this incredible collection of people along seven states who had been fighting and suing each other for years and Buzz knows an awful lot about that whole story more than I do, have created a system of shortage rules and

they've come together recognizing that they actually need to work together. So there are things folks are doing to manage it but the situation on the Colorado is one that all of those states including California has to keep their eye on because with climate change again there's gonna be less left in storage, less snowpack and the like. I mean the snows that came in this year bailed out going below the red line, but they certainly haven't bailed out Lake Mead and those reservoirs are still in trouble and they're silting up.

So there's a whole host of issues we have to deal with. Fortunately, as folks have said, there are a lot of solutions that we haven't yet even begun to tap at the level we can tap them. So there's an awful lot that we can do. People like Don is one of my heroes for not only being an early adopter, but being brave and doubling down and doing really creative work that his colleagues can see. Others are doing work in floodplain management to setback levees and figure out how to floodplains for flood control, but also to help fish and birds. And it's that integrated kind of thinking with environmentalists, government agencies and farmers figuring out how to solve problems versus talking past each other that we need more than ever and I'm seeing it happen.

Announcer: We're talking about water stability here at Climate One. You can listen to all of our programs and subscribe to our podcast at our website: climate-one-dot-org. We'll continue the conversation right after this.

Announcer: This is Climate One. We're talking about the challenges of water whiplash with Buzz Thompson, professor of natural resources at Stanford, Felicia Marcus of the California Water Resources Board, and Don Cameron of Terranova Ranch.

Let's back to our discussion - here's Greg Dalton.

Greg Dalton: Don Cameron, Felicia Marcus called you a hero. Tell us about the crops you used to grow cotton in California. A lot of people criticize water intensive crop in a dry state like California also rice and alfalfas. So tell us about how the crop mix has changed recently for you on your farm?

Don Cameron: You know we changed for a lot of reasons, part of it was economic. We tended to switch to crops that were specifically grown in California so we didn't have the commodity competition that we did. And to do that we had to be more precise in how we farm and everything we did with the crops that were growing. So when we invested in subsurface drip irrigation we were able to really cut the water back and actually freed up water. We used to have to idle fields during the summer when we grew some of the other crops. And now we're able to actually pump less and farm all the land throughout the year.

Greg Dalton: And you farm, you grow almonds. Climate One did a Facebook post once with almonds with little devil horns on them; it got a lot of traction. People like to villainize almonds because they're what, how many gallons of water per almond. So talk to us about the water intensity of almond and, you know, should they be grown in a dry state in a drought?

Don Cameron: You know, when we start talking about which crop we should grow as a farmer we look at the economic side of it. We know that any crop we grow is gonna use water whether it's almonds, whether it's tomatoes, carrots, onions. I did a calculation over the weekend and on our farm which is, I just looked at about a little over 6,000 acres. We farm and produce enough calories if someone was going to eat nothing but vegetables and nuts for a year.

But we would feed 92,000 people for a year for a full year with the calories we grow. So, you know, everything we do uses water whether it's, you know, for growing almonds for growing tomatoes, carrots, the wine grapes. We have an emotional attachment to the food we eat and I think to restrict

one crop and to tell somebody that they can't grow certain crop is not gonna work.

Greg Dalton: Yeah, government doesn't want to do that either. It's time for our lightning round at Climate One. We go to brief questions, one-word phrase or answers from our guests here talking about water whiplash, drought and floods in the West and in the country. I'm gonna mention a noun and our guests are gonna mention the first thing, word or phrase that comes to mind, unfiltered. Tell us what you really think. Felicia Marcus, cotton.

Felicia Marcus: Soft.

[Laughter]

Greg Dalton: Don Cameron, Monsanto.

Don Cameron: Technology.

Greg Dalton: Buzz Thompson, alfalfa exported to Japan to feed cows.

Barton Thompson: An idea that would not make any sense if you actually priced water properly and didn't have a lot of empty ships heading back to China and Japan that needed something on board. Sorry that was more than two words.

Greg Dalton: Call that a market failure.

[Laughter]

Don Cameron, non-till farming.

Don Cameron: Great for parts of the country, doesn't fit our operation.

Greg Dalton: Felicia Marcus, U.S. Secretary of the Interior, Ryan Zinke.

Felicia Marcus: Interesting.

Greg Dalton: Buzz Thompson, hamburger.

Barton Thompson: Lots of water.

Greg Dalton: 600 gallons in each burger. True or false. Don Cameron, hedge funds are investing in almonds and other farms now and expect to make a killing when water becomes more scarce and valuable?

Don Cameron: There's some truth to that.

Greg Dalton: Buzz Thompson, farmers should pay more for water than the pittance they pay now?

Barton Thompson: Yes.

Greg Dalton: Don Cameron, farmers would use water more wisely if they had to pay more for it?

Don Cameron: Definitely.

Greg Dalton: Okay. Going on our lightning round, Felicia Marcus. True or false. Skiing is a sport with a bright future?

Felicia Marcus: It depends on where you are.

Greg Dalton: I interviewed the heads of some ski resorts Jackson and Whistler and Aspen. And they said 30% of the ski resorts in the country will go out of business in the next few years, the next couple of decades. True or false. Buzz Thompson, you will drink recycled pee water one day?

Barton Thompson: I already have.

[Laughter]

And it was great.

Greg Dalton: Don Cameron, true or false. People get upset when farmers make money?

Don Cameron: True.

Greg Dalton: Felicia Marcus, the price of food will rise as water becomes more scarce due to severe weather driven by climate disruption?

Felicia Marcus: Probably.

Greg Dalton: Okay, let's give a round of applause to our guests for getting through that lightning round.

[Applause]

Greg Dalton: Felicia Marcus, what are some of the lessons from the drought six years in California, the West. Do people really change their habits, are we going back to watering our lawns in the old ways or is it -

Felicia Marcus: Oh, a tremendous number of lessons. I think folks, you know, if you think about the drought of the 90s which when I was in L.A. we learned how much water we were using indoors and that retrofitting our toilets and showers could save an incredible amount of water without us really doing that much, really big focus. In this drought, people learned how much they're using outdoors. I think people didn't realize that on average in urban California we use half of our water and that's an average outdoors on ornamental landscaping. I think people tend to water their lawns either the 3 feet under their lawns, they water so much it runs in the street, that causes storm drain pollution. They are watering lawns that came with the house that they never thought about to be green as if they were in Scotland, in the middle of the worst drought in modern history, that's our thing. I think folks learned that they didn't need to do that and the public stepped up big time to change out their lawns for more drought tolerant, even lawns, let alone other kinds of landscaping and ate up rebates, snapped up rebates as fast as agencies put them out.

So tremendous public education, public response to the drought and we're all in this together and an incredible knowledge about what we can do outdoors. I think that was really very important. I also think people learned a lot about climate change during this drought because there was a lot of conversation about it. I think the polls were remarkable about folks recognizing that we were vulnerable and that we needed to use water more intelligently across the state, a lot of impetus for that. And there were a lot of people who did reach across traditional, not everyone but there were an awful lot. I would say there were more drought angels than opportunists and a lot of relationships formed where people realize that we have to use each drop more wisely both for food and for fish and wildlife and all the different folks who can use water along a watercourse.

I also think actually that after a year of picking on almonds or picking on a little soundbite or whatever your favorite thing was by the next year. I saw a lot of good stories about people understanding how much water was in their food. You know, people consume more water in the food they eat than on their lawns and it's not like farmers are growing food and put it in a bonfire and have a happy proud of ourselves party. They do it so people can eat it. So I think we have a higher sophistication of the fact that water grows our food. I, for example are particularly fond of the water used to grow avocados. So don't take my avocados away from me.

You know, so but I think people have a recognition that now that they didn't have before. Does everybody have it universally know but a tremendous growth in public awareness. And we have to hope that that drive continues as people figure out how to give the support that's gonna be necessary to do all the smart things, whether it's a long-term efficiency and conservation, recycling. Got over the hump, you know, with people, I have drank it too. I mean astronauts been drinking it for a long time, it is not rocket science to recycle water. It is just, you just have to have the will and the regulatory certainty that it's gonna be safe we've been working on all of that. We have storm water capture plans we have storm water capture working in a lot of communities. But L.A. has huge plans to capture water rather than letting it go to sea and getting it into their groundwater basins, putting recycled water into groundwater basins. You have agencies working across traditional divides in my old hometown L.A. between the county and the city which never used to talk to each other between the water department, water supply department and the water, you know, the wastewater department where I used to work.

And they sort of hated each other. Now everybody's coming together to figure out how do we manage that water and green L.A. the most park poor city in the country. So that's a space to watch over the next decade.

Greg Dalton: Buzz Thompson, The Hoover Institution at Stanford conservative think tank in Stanford did a poll that said that the drought concern actually cut across partisan lines, brought people together and there was evidence of sharing and sacrifice. So your thoughts on how the drought brought people together and now that the drought is over does that evaporate?

Barton Thompson: Yeah. So the drought definitely brought people together. And I think, as actually Felicia intimated earlier droughts and any type of emergency brings communities together and everyone's willing to share. And I think water is particularly unique in this particular area. I think everyone recognizes that water is a community resource and that everybody has a responsibility during a period of drought to contribute towards reducing their water use. Having said that, although I'm pretty much in the same optimist category as Felicia the experience worldwide has been that when a drought ends, people forget about water. If you talk to people in Australia, they'll tell you that the end of the millennium drought within a year, people were no longer talking about water resources. They were no longer talking about how they would prepare for the next drought. I think there are a lot of practices that end up being ingrained. In my particular case, what we did was we tore out most of our lawn. We put in an intelligent irrigation controller that now actually turns off the water when it rains. Also gets all the weather information and uses that to adjust how much water we're using on our gardens. So we've made that change, but we could go so much farther than we already have in making sure the future droughts are better.

And we have a terrible tendency in California to basically make sort of a leap forward every time we have a drought. And then when that drought ends, we sort of just stay on that new plateau and it takes another drought to move us that next step. So one of the things we have to figure out is how we get people to pay attention to a drought when it's a period of floods and how and then we go back in the drought people still worry about the floods and say, hey we have to be prepared to make sure that levee doesn't fail the next time that we have a flood. So we have to get people to think

about water comprehensively.

Greg Dalton: Don Cameron, climate is a dirty word in certain circles a lot of the country. Do you talk about climate with other farmers or is that something you kind of dance around?

Don Cameron: You know, I also went to Australia and there they called it climate variability. I think that a lot of growers don't like to use the word climate change. Like I said myself, I recognize that we're seeing change in climate and we're changing the way we farm to deal with it. We're gonna take advantage of it and we're gonna recognize it and we're gonna put it to the best use we can. But, you're right, a lot of, I think a lot of growers have a real hard time admitting climate change.

Greg Dalton: Why should people who live in other parts of the country, why should they care about drought, floods in California. How does it connect to their food?

Felicia Marcus: Avocados.

[Laughter]

Don Cameron: Felicia's right. It's an emotional attachment. And California provides such a wide variety of fresh produce nuts, grapes, wine to the entire U.S. and really to a lot of the world. We have such unique climate here in California that we can grow almost anything and we do a really good job at it. Our climate is perfect for that. So the rest of the U.S. relies on California produce. I always make it a habit when I travel I love to go to the grocery store. See what's in there and see where it's from. And I've traveled throughout the East Coast, throughout the U.S., you know, Canada, the world.

And you always see the U.S., you see California stamped on the outside of the box. So it's always amazing to me how far our produce goes. I mean we grow a lot of different crops. We're growing crops like the chilies are gonna go into Sriracha sauce, peppers that go into Stouffers frozen entrées. We grow for Amy's organic that goes around the world. I mean we know where a lot of our food does go, the tomatoes, those organic pizzas, conventional pizzas, spaghetti sauce. So what happens in California affects the rest of the U.S. and part of the world.

Greg Dalton: People think that organic is basically, you know, is the single, it's the best thing that people can buy, you pay more for it. But does organic, and water is that part of this designation or not?

Don Cameron: People don't like to talk about that side of the organic. We know that in California where we have to irrigate the crops, typically and not always, but typically our yields are lower for the organic crops. Which means you're either taking up more land to produce the same pound or whatever you're growing, produce. So yeah, you're using essentially more water to produce that organic crop. We tend to grow for markets and if the market is favorable we're gonna grow if it's organic, conventional, different crops. We've grown, like I said, we grow over 25 different crops on the ranch we have quite a diversity there. But we will grow what people wanna buy and we'll grow it the way they want us to grow it.

Greg Dalton: So if I heard you correctly, to feed the world on organic food will require more land.

Don Cameron: More land and in an area where you're irrigating more water.

Announcer: We're talking about how to keep our water flowing in both wet times and dry. Greg Dalton and his guests will be back in a moment. This is Climate One

Announcer: This is Climate One, changing the conversation about America's energy, economy and environment. You can listen to all of our programs and subscribe to our podcast at our website: climate-one-dot-org. And feel free to leave a comment for us.

Today, we're talking about drought, flood and how to balance our water supply in extreme times. Our guests are Felicia Marcus, chair of the California Water Resources Board, California produce grower Don Cameron, and Buzz Thompson, former director of the Woods Institute for the Environment at Stanford.

Now, back to our program. Here's Greg Dalton.

Greg Dalton: Buzz Thompson, we haven't talked about desalination that often comes up in dry time. San Diego plunked out about \$1 billion to do desalination. Are we gonna see more desal in the future to try to even out these extremes of too much water and too little?

Barton Thompson: Desalination right now is still extremely expensive. And so if you have any other available water supplies for example, recycling water, desal normally does not make very much sense. But there are some communities that because of where they are, are inherently short on water. And if you run out of cheap water, desal is something that you know if you're by an ocean, you're always gonna have enough water to use in your city. So Monterey is gonna go to desal and that makes sense for Monterey to go desal. There are other communities like San Diego where they're at the end of the line for the delivery of water.

And they have very little groundwater in San Diego, very little local water supply. So San Diego has built a desal facility not because it is necessarily the cheapest way for them to get water at this particular point in time. But they want to make sure that if at some point they can't get water to San Diego from all of their various other sources that they have an adequate local source of water. So San Diego has done it not because they don't have any other options, but because of the security that they get from having a local desal facility. So desal right now makes sense in some areas but not in most areas over time. However, as we run out again of cheap water, people are going to turn more and more to desal.

In addition to that we're looking at new technologies that could significantly reduce the cost of desal. Desal is very expensive today because of all the energy it uses. And of course all the energy it uses also contributes back to climate change, so it's not the best solution to the problem of climate change driven drought. We are right now however, using far more energy in our desal than what the physicists would call the theoretical minimum amount of energy that's necessary for desalination. That tells us that technologically, there's still room for significant improvement. And so scientists throughout not only the United States but the world are looking at new membranes and new technologies to bring down the cost. And I'm sure it will come down, I just don't think it's gonna come down probably by the time of our next drought, which is likely to be within the next five years.

Greg Dalton: And also speaking of water security. The Great Lakes, largest body of fresh water they have been provided water security to the American Midwest, but they've been having algae blooms lately that are causing great concern. Is that connected to climate Buzz Thompson, and what does that pertain for warming water, warming temperature?

Barton Thompson: So two things, the first is that yes, those algal blooms are related to changing climate. And one of the things that we know is, is that as the temperature rises we're going to end up with worse droughts because evapotranspiration rates are going to go off as Felicia mentioned earlier, we'll also have smaller snowpacks. Those snowpacks will melt earlier in the year which in a flood year like this makes things more difficult because it means it's raining and the snow was

melting at the same time which simply increases the difficulty of capturing that water.

And in addition to that, without warming water you can get algal blooms and you also have greater stress on our fish species which are already in real trouble because there is less water in the rivers and there are dams on those rivers. So climate change has a whole series of problems that we need to worry about. Having said that the other thing is is that the Great Lakes will not let any of the water out of the Great Lakes area for use elsewhere in the country. The one thing that they got passed through all the Great Lakes states and approved by Congress is a compact that says the water has to be used within their watershed. So even though in California and we might want to use water from the Great Lakes, it's illegal.

Greg Dalton: We're talking about water at Climate One with our guests Don Cameron, a farmer from California Central Valley. Felicia Marcus, a water official in California and Buzz Thompson, professor at Stanford Law School. I'm Greg Dalton.

Let's go to our audience questions. Welcome to Climate One.

Female Participant: Thank you. I'm Felice Deats. The issue of climate change is an expensive one. You're talking about the increase in food; you're talking about the increase in maintaining infrastructure. And I think that's only just beginning to be seen how much it's gonna cost. Is there a state or local or federal agency that's going to help deal with these rising costs and the impact on the people?

Greg Dalton: Food impacts. Buzz Thompson, who is looking at this whole picture of food and water price pressure?

Barton Thompson: So as you pointed out, climate change is going to impose huge costs on our economy. And given that the federal government is at the moment not in the business of providing money for climate change mitigation or adaptation and that our state government is under greater water - I'm sorry, greater financial pressure than before. A lot of the cost of that is gonna end up on the local communities. Bottom line from my standpoint is it's a good reason why we should be mitigating climate change and not simply assuming that we can adapt to it.

Greg Dalton: So food and water is gonna cost more. Let's go to our next question. Welcome to Climate One.

Male Participant: Hi, thank you. I'm Spreck Rosekrans. Greg, I think you throughout the figure of \$50 billion to fix our water related infrastructure whether that's upgrading or maintaining or new dams, new levees, new groundwater recharge, whatever all those things are. My question is how do we figure out how to spend that money efficiently. Dams are highly political. Some people love them, some people hate them. Some people say they're cost effective, others don't. And we don't have enough money to do everything and maybe we don't want to. But how do we get around the politics and get into a world where we do the economically efficient things statewide to provide for all our needs?

Greg Dalton: I'll even say that nationally, we have some bipartisan support for infrastructure push. Republicans and Democrats, water infrastructure, Buzz Thompson, could be part of that.

Barton Thompson: It definitely could be part of it, it should be part of it because we need to invest not only in our dams but we also need to be investing in for example, our flood control levees. There are agencies in I think every single state that look at dam safety and those are supposed to be expert agencies, they tend not to be overly political. And I would look to them to help prioritize where we

should be spending our money for dam improvement.

I think there is another issue that is likely to be relevant here, which is that for many of our dams they do have many more years of life ahead of them and we should be investing in repairing them. There are probably some dams out there that maybe should be taken down at this particular stage rather than investing a lot more money in them.

Felicia Marcus: Like they are for takedown the climate dams.

Barton Thompson: That's right.

Greg Dalton: Don Cameron, there is a bias potentially in building dams. Unions like the job; they're visible big construction projects. What you did flood your field, put water back in the ground. Do you think that doesn't get enough attention because it's not as sexy and perhaps the unions don't like it as much?

Don Cameron: No. I think that it really, we brought it to the forefront in 2011 and we're doing it again this year. You know, we have issues part of our problem is that groundwater recharge water for groundwater recharge is not a beneficial use at the federal level and at the state level. And we'd like to see the law changed, putting floodwater on ground for recharge should be beneficial.

Greg Dalton: Benefits you. And that's a particular use of legal term there for use of water. Let's go to our next question.

Male Participant: My name is Carter Brooks. I'm an artist and philosopher of Climate Art. I wanna go to the whiplash side, the flood side of things. Some people comment every once in a while that Sacramento will be the next New Orleans and sort of the idea being that as this as precipitation falls more as rain than snow or it melts faster, we could have, you know, all of the Sierras just dump into the valley. I wonder whether anyone can comment on whether that's a fantasy or whether that's a real worry.

Greg Dalton: Felicia Marcus.

Felicia Marcus: Well, I would just say that, thank you for that point. I think in this year's rains, if had not been for that Yolo Bypass that I mentioned that both helping fish and doing flood control, millions and millions of dollars and the efforts that have gone into place to do that do weirs and the overflow weir, you would've seen flooding in Sacramento this year. I think as we do more and more of those really large setbacks that we manage for multiple benefits where people can farm when it's not in flood stage, there'll be flood easements and the like, I think that is the next phase of flood control for the Sac Valley and other places. The way we make it in a more constrained world without breaking the bank is to get multiple benefits out of each drop of water and every public dollar that we spend.

But doing that requires not just building another big thing, it requires people coming together, working across traditional geographies, disciplines and cultural divides. And that's why I was talking about optimism at these experiments happening where folks figure out how to talk to each other and do something where the whole is greater than the some of the parts because they did something unusual. And the Yolo Bypass story is a really good one to tell for Sacramento and they're going to need more of it.

Greg Dalton: Let's go to our next question. Welcome to Climate One. We're talking about water whiplash.

Male Participant: And Don Cameron, Bill Kelly with SL Environmental Law. I applaud you in flooding the fields to recharge your ground water. Are you concerned about some of the contaminants had been existing in the groundwater eventually getting into the aquifers.

Don Cameron: Right. Our area is, you know, it's been in farmland for quite a long time. So we do have chemicals that we do use in farming, but they're usually very short-lived. Nitrates are an issue, we feel with the amount of water that we're putting on that we're actually gonna have a dilution effect long-term. Our water quality is going to actually improve and it all depends on the area where you're doing the recharge. But this had been farmland, you're right, we were very concerned about nitrates, salts, anything that we could move down. But we manage it accordingly, we changed our management practices when we are gonna be doing recharge.

Greg Dalton: Let's go to our next question. Welcome to Climate One.

Male Participant: Thanks. My name is Todd Mitchell. The panel mentioned the challenges to maintaining public awareness of the importance of effective water resources management in times other than the cyclical extremes of drought and flood. And I was just wondering if there is any aspect of the public educational curriculum that sort of instills that awareness in the decision-makers of tomorrow.

Greg Dalton: Buzz Thompson, you're an educator, question about educating future generations about the sort of the water extremes in the future different from the kind of the predictable, well, more predictable path we've been in.

Barton Thompson: Yeah, absolutely one of the things that could make a huge difference is education about water issues, particularly at the elementary school and junior and senior high school level. I mean my kids were recycling far sooner than I was and in many ways I think our kids are the people who come home and teach their parents the important lessons. And so if we can do that in the water sector, we know we'll be in better shape.

Greg Dalton: Teach your children well and there's a - listen to that, yeah, teach your parents well too. We've been talking about water whiplash and the new normal of more droughts and floods in the United States or more extreme droughts and floods. Our guests were Don Cameron, a farmer from California Central Valley, Felicia Marcus, a top water official in California and Buzz Thompson, a professor of natural resources at Stanford Law School.

This program is underwritten by the S. D. Bechtel, Jr. Foundation. Thanks for joining us everyone. We'll see you next time.

[Applause]

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