Custom Irrigation: How Treated Sewage Could Be Perfect for Crops

With a little tweaking of the sewage treatment process, it's possible to create custom blends of irrigation water for farming. David Jassby, a professor of environmental engineering at UC Riverside, explains how.

Matt Weiser, Water Deeply, 10-10-16

California's sewage treatment plants produce billions of gallons of wastewater every year, nearly all of it dumped into rivers or the Pacific Ocean like garbage. And this is how it's done all over the U.S. and most of the world.

But what if we began looking at treated sewage, instead, as a valuable resource?

That's what David Jassby and his co-authors Kurt Schwabe and Quynh Tran at the University of California, Riverside, did in a recent study published by the journal Environmental Science & Technology. They asked: Instead of dumping treated sewage into the environment like a waste product, where it causes lots of problems, could it be treated to custom specifications to irrigate particular crops?

The answer they came up with is a resounding "yes." Although, as always, there is some fine print. Water Deeply recently spoke with Jassby to learn more.

Water Deeply: How did the idea for this study come about?

David Jassby: The idea came about from discussions with my colleague Kurt Schwabe. He's a water economist. I'm an environmental engineer, so I have an interest in wastewater treatment, among other things.

We started wondering: Can we take existing wastewater treatment technology – nothing new, things that are on the market already and have been tested for a long time – and arrange them in such a way in treatment train to generate water that's idea for citrus or turfgrass, with the right levels of nutrients and salinity? We chose those because we're in Southern California, where there's lots of citrus and golf courses. And can we do this in a cost-minimization framework?

This idea is really relevant only to places like Southern California, where you have this rural-urban interface, where you have plenty of wastewater and plenty of applications that would use that water. If you're going to the Central Valley of California, where there's a huge amount of agriculture and very little people, really, this is not relevant. The volumes of water they would need far exceed the wastewater generation capacity of all the cities combined, I imagine.

In the grand scheme of things, the higher-level view is really to take a wastewater treatment plant that currently is just a waste disposal system which generates its income from rates. The idea is to offer the wastewater treatment facility an opportunity to generate a new stream of revenue. If they offer water that is of high enough quality, and potentially excellent quality to satisfy a particular crop's demand, maybe they can actually sell it rather than just discharge it into some river.

Water Deeply: And what were your results?

Jassby: We found that, yes, we can tailor the wastewater treatment to a particular crop, and we can make excellent water that not only will satisfy the crop's requirements as far as salinity, but also provide an appreciable amount of nutrients in the form of nitrogen, phosphorus and potassium. Which means the farmer and golf course operator can use less synthetic fertilizers. So that's good news.

The mixed news here is how much it costs. In the best case scenario for citrus, the cheapest case was 53 cents per cubic meter for a large wastewater treatment plant. That's how much it would cost to make wastewater that is ideally suited for citrus. That's quite expensive compared to what you would typically pay. Compared to the cost to pump out of a groundwater aquifer, which is about 19 cents per cubic meter. But that, of course, changes with the depth of your well, and doesn't account for the benefit of the nutrients in the wastewater. There is some additional value there.

This is relevant to a place where people have no choice. If you are adjacent to an urban environment that generates significant amounts of wastewater, and your groundwater is either regulated or gone or degrading, this might be a viable solution.

Water Deeply: It's sort of surprising that we aren't doing this already.

Jassby: I know, right? It's shocking. When we started thinking about it, the first thing you do is a literature search, and I said to myself, "I can't believe nobody has ever done this before." But they haven't. It was low-hanging fruit.

But we sort of already are doing it in some cities where we have these purple pipes and it's used on freeway medians and landscaping. The issue there is, the treated wastewater coming out of the plant is oftentimes a pretty low quality product, and leads to long-term soil degradation.

What really gave us the impetus for this is looking at things happening in Israel. In Israel, they've been using wastewater for decades to irrigate their crops. But they're having soil salinization issues. Over time, there's a buildup of, particularly, sodium in your soil and it starts hurting your crop yields and it's very difficult to get rid of.

Water Deeply: Your findings seem timely, since California's new Sustainable Groundwater Management Act will require many areas to reduce reliance on groundwater.

Jassby: Most of the aquifers around here are overdrawn, so they're going to have to reduce their drawdown. I would think the people that get damaged from that are farmers, because they use far more water than houses. If that's the case, you can move to another state or get water from another place, and one way we keep generating a lot of it is wastewater.

Water Deeply: How feasible is it to modify wastewater plants to produce these custom blends?

Jassby: It's very feasible, but it's going to require the investment of significant capital funds. If they do have a salinity issue – and we're finding that a lot of them do – then they're going to have to put a desalination unit in, and that's not cheap. There are also issues with brine disposal on that, although that can be mitigated.

Water Deeply: But would they have to treat to drinking water standards on salinity?

Jassby: No. They can just desalinate enough to make water that's suitable for whatever crop they're interested in. They can do that by blending. You just desalinate some of the water to make a product that has the right salinity.

You also may run into a delivery problem. The plant would have to create multiple ways to deliver each custom blend. There is already an existing purple pipe conveyance system that could be used.

Water Deeply: It seems partly what you're proposing here is to link wastewater back to the land, and even back to our food supply.

Jassby: We didn't discuss this in the paper, because it's complicated and controversial. But in highly urbanized areas like Southern California, we basically reuse most of the wastewater in one way or another already.

For example, I live in Riverside and several million people live in this area and they use a lot of water. And that water gets treated and it goes into the Santa Ana River, and the Santa Ana River eventually disappears into the ground somewhere right on the border with Orange County. So really, this is a groundwater source for Orange County. That's how they recharge their aquifer.

So what happens now if we start diverting these flows? There are two issues here. There are human needs and also environmental needs. You have to maintain certain flows in rivers for endangered species. What happens if we start using this wastewater? People will always look down on this – discharging wastewater into a river. But in many cases, certainly in the Southwest, that's what is mainly in the rivers, otherwise they'd become dry. At this point, there's very little water that goes into the ocean.

Now we're removing a fraction of this water and putting it to other uses. So there's a regional-scale water balance that has not been done, to the best of my knowledge, and it has to be done. How would this actually get implemented? It gets very tricky, very quickly.

We need to adapt a more global view of these issues. These water sources are all interconnected. We don't have any surplus any more. There's more and more people all the time. If the climate modeling is correct, and I tend to believe the experts, it looks like it's going to get drier here. The reality is that we're running out of water down here.