

Ep. 5 Computer Models as a Tool For Sustainable Water Planning

Sun, Feb 20, 2022

SUMMARY KEYWORDS

water, planning, reservoir, WEAP, future, impacts, climate, tool, model, California, ecosystem, groundwater resources, management, scenarios, sustainable

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JC

0:17

Water is fundamental to human development, from drinking water and sanitation to agriculture and more. You're listening to Water Stories, a podcast series where you will learn everything about securing water, energy and food security for all of us.

Hello everyone, I am Juan Carlos Giraldo and welcome to episode number five for Water Stories. I would like to start by saying that the primary goal of technology and planning in water management is to provide high quality, good amount and sustainable water for cities, farmlands and different ecosystems around us. In this episode with our guests, we will discuss everything that involves an essential water modeling tool developed by Stockholm Environment Institute called WEAP.

Once again, my co-host is Vishal Mehta. Vishal is an environmental scientist in the Stockholm Environment Institute. And his work is focused on water research and forest conservation. He's based in in Davis, California. Hello, Vishal, how are you?

Vishal

1:27

Hi, JC.

JC

1:28

Vishal, would you mind to introducing our guest?

Vishal

1:30

Sure. It's a great pleasure to welcome my colleague, Jack Sieber. Jack and I have been working together for more than 12 years. Jack is the Deputy Director, Chief Technical Officer of the US Center of SEI, the Stockholm Environment Institute. And once in a while, he calls himself the mother of WEAP, which is the software that we use for water resources planning. And so welcome, Jack. I'm very happy to have you.

Jack

1:55

Thank you, Vishal.

JC

1:56

Hello, Jack. How are you? Happy to have you today as a guest.

Jack

2:00

Thank you, JC.

JC

2:02

Jack, before talking about this essential tool called WEAP, I want to ask you what exactly does plan mean in water management? What are the ingredients of good planning? And also who plans?

Jack

2:16

Yes, several different planners. So you could have city planners that are looking to manage their water resources, supply and demand, water quality; you could have a larger level of regional or statewide planners, who are really trying to oversee the regional resource and trying to coordinate different smaller regions. You could have nationwide, countrywide planning.

All these different planning levels really have maybe slightly different focus, but they all have the same thing in mind, which is really trying to make a sustainable plan for the future. So they sort of look at the water resources, all the different aspects of it, try

to make sure all the different sectors of society, have enough water and have high quality water to meet their needs, both now and in the future.

JC

3:03

That's great. Vishal?

Vishal

3:05

Yeah. And you know, like Jack said, a basic feature of resource planning is meeting supply and demand. And essentially, when you add on the word sustainable water management, different aspects come into the picture, come into play. So for example, it's not always about finding the cheapest water resources options for the future, to meet growing demand. For example, you want to make choices that are wiser in terms of the environment, in terms of equity, in terms of many other factors, including, but not limited to, costs. And that's where a tool like WEAP comes in, that we'll be getting into.

JC

3:46

Thank you, Vishal. You know, last week I read articles, I listened to a podcast. Also, I'm reading right now a book about management and ESG. And all say that water is becoming an essential topic for scientists, companies and business leaders. All these sources had something in common: Technology will help solve water scarcity to facilitate access to this element, to this important element in our life. Speaking about technology, I want to ask Jack, what does the acronym WEAP stand for? And when was it created?

Jack

4:20

OK, WEAP is the Water Evaluation And Planning system. It was first conceived and constructed back in 1988, back in the dark ages, and I've actually been working on it almost since then. So it really has become now my life's work. So it was really conceived as a way of looking at a way to balance demands and supplies to really come up with an integrated plan for a sustainable future.

So at that point, often water planning relied, I would say, overly much on supply focus. So we need more water, let's build another reservoir or another pipeline, or another treatment plan, without really considering the demand side of the equation. How much water do we really need for our uses? Can we be more efficient? Can we reuse water? Can we look at different sources or look at different needs such as for the

environment or ecosystems? So it really is trying to be a more holistic picture rather than before, the earlier just supply-focused, let's build more pipelines to get more water.

JC

5:15

Interesting, especially seeking to be more efficient, which is very important as you mentioned. Vishal?

Vishal

5:21

Yeah, and one of the major features of WEAP, that Jack has developed over so many decades, is that it allows you to create different futures. So as I mentioned, we have to make choices into the future. And each of these is a scenario of the future, which are, you know, different ways that future can play out. And WEAP is essentially a software program which allows you to build these different scenarios. And then to evaluate them quantitatively and compare them and then to make a choice as to what the best option is for the different futures we can imagine.

JC

6:01

Thank you, Vishal. You know, I watch some tutorials on how WEAP works, and it's impressive all the elements involved in water management: rivers, wastewater, basins, reservoirs. For me, for example, catchments got my attention. So Jack, what are the main features of WEAP, in your opinion, that you know very well, this essential tool for water management?

Jack

6:25

I would say one of the standout features of WEAP is it really combined sort of a physically based hydrology model, with a planning operational context, the human constructed environment, and how to move the water around. You can look at all the climate variables and looking at different possible future climate scenarios, and how they might alter the hydrologic cycle.

So that's one part. And then the other part is you can see how the impacts in terms of the supplies: reservoirs, groundwater sources, rivers, and human and environmental demands. So you can really look at both sides of those equations, play with both, and look at different scenarios, as Vishal talked about, because nobody can predict the future. Somebody once said, all models are wrong, but some are useful. So no model

will perfectly predict the future because there are too many uncertainties. But with different scenarios, you can construct different possible future paths and see how, if the climate changes in this way or population grows this way, what would be the impacts, what would be the possible management options we would have to respond to those changes, so we can complete a sustainable system?

Vishal

7:34

I just wanted to go back to thinking of the listeners, when Jack said that it integrates hydrology with all our water resources infrastructure. By hydrology, what we mean is, you know, how rainfall or precipitation is converted into streamflow and how much of it, you know, is lost to evapotranspiration, how much of it enters the soil, how much of it goes into groundwater recharge. So that's what Jack means when he says hydrology, and there are not that many tools out there that can simulate, using computers, both the water balance, which I just described, as well as then feed it into canals and reservoirs and hydropower, and so on. So that's definitely one of the hallmarks of WEAP. And the second one is that it's a very transparent system. So you know, it has a graphic user interface that you can easily work with.

JC

8:33

Thank you, Vishal. Jack, WEAP as a tool is used by research and planners in organizations around the world, right? With more than 28,000 users in 180 countries. Any particular situation, any region around the world that has caught your attention during these years that you would like to share with our audience?

Jack

8:54

Certainly, yes, WEAP is really used in many different countries and states around the world. Many countries have embedded it into their planning process. Yes, we have many projects in Latin America, but also in other parts of the world: South Korea, Jordan, Germany, many states, countries in Africa, many states and cities in the United States. So the state of California has adopted it, now, almost 20 years running. It's one of their essential tools for water planning. So every five years, they come up with an integrated water plan, trying to look into the future and come up with different strategies.

JC

9:31

Jack, any particular examples that you would like to share with the audience that you remember or cross your mind right now?

Jack

9:39

I think California is probably one of the better examples in my mind of a very large system. Very sophisticated planners been working on this for decades, I mean, over 100 years. There's not much water in California, so they've had to be very ingenious, and they've been using WEAP, and it's, like I said, it's part of their process. So they've been using it looking at different climate futures, looking at different reservoir operation policies, looking at different ecosystem requirements and different regulations and how that might impact farmers or cities. I think it's really been a key part of California state water planning. So I think that's one of the impacts – for me, it's one of the standout stories of how WEAP has been useful in the real world. It's not just sort of an academic exercise, but really, I think it's useful as a decision support tool to planners and policy-makers.

JC

10:28

That's interesting. Vishal?

Vishal

10:30

In addition, what Jack mentioned is that it's a tool, right? So we use it, SEI staff use it in wherever we are working in building collaborations, you know, collaborative water resources, planning and modeling, using this quantitative tool, so that people can see whether you are farmers or planners or city residents or, you know, whoever you are, in a particular region, we can have a common basis for making decisions, instead of doing mostly qualitative work. So that's one of the key things to remember is that we actually use it in a very formal collaborative planning exercise and mode. That's one of the things I wanted to point out.

And the other thing I wanted to point out is that, you know, it's one of those tools which you can build a water model for your own house, you know, you can do a demand and supply, kind of analysis, using it from the scale of your own house to a city, to as Jack mentioned, river basins and countries. So it's very scalable that way in space.

And I also wanted to mention that some of us, including Jack, are now are always innovating. We are trying to use climate change projections from the IPCC to embed

into the tool. And we have also a very nice example, is that we are also now trying to use it in forecasting mode. So not just planning itself, but also using climate forecasts, like you hear about on the news and so on. Especially given that the West is in a deep drought and has been for a long while.

JC

12:13

Great insights, Vishal and Jack. But how WEAP can help water management for future scenarios, for example, would involve policymakers, business, and society itself?

Jack

12:27

I can give you a concrete example of how the types of analysis and types of decisions and impacts can come up. So constructing a scenario where you've got all the different aspects of the water supply system: a reservoir to store water above ground, underground aquifers, the hydrological cycle driven by climate, human needs for agriculture or industry or for drinking water, ecosystem needs. So layered on that model of the current situation, you look at future projections of how climate might change or population grows, or different agricultural patterns, and think about how much water will we have? Will we have enough water? And often the answer is no, at least with the current system and the current strategies. That's not even taking into account ecosystem needs, which often are short-changed now. So trying to think about different policies, how can we change the way we operate our reservoirs? How can we change our irrigation practices to be more efficient? Maybe we can't have as much land under irrigation as we do now. It's not sustainable.

So all these are different things that could be impacted by what the model says could be happening in the future. So do we have to change our policies and change how much water we give to the farmers or change the prioritization so the cities have priority over the farmers, perhaps, or we change which crops we can grow – some that use too much water, for the impact? So those are the types of decisions that could be made.

Vishal

3:51

Yes. And to make it even more concrete, what Jack said is that the planning context is, I think, is what you're asking about, right? So for example, I'll tell you right now, I live in Davis in California, which is in Yolo County. And we are working with stakeholders here in this county, using a WEAP model under the SGMA Act, which is the Sustainable Groundwater Management Act. If you remember, we had another podcast with Chuck

when he was talking about it. Essentially, the Act is the framework for the planning, the law. The law that requires that every basin also needs to come up with a sustainable groundwater management plan because groundwater has been overused in California for a very long time.

Now, because the law requires every part of California to implement this plan, and show how will your groundwater resources be sustainable into the future, that sets the planning stage, right? So now we come in with the WEAP model which says, OK, well in droughts in California, farmers use a lot of groundwater. That's not good for the groundwater resources. Well, what are our options? Can we recharge that groundwater with excess water in the winter, if there are floods? You know, those are the types of scenarios we can start building. But the drive and the framework to get into a planning exercise is coming from the law. So it's required by law.

JC

15:17

I remember when I spoke with Marisa Escobar and she said that this tool will help policy-makers look at the big picture, you know, and to make the decisions. Jack, where people for example, can reach more information about this essential tool, which is very, very interesting? And it's a good thing because it came in a lot of languages, you know, Spanish, Portuguese, German, English, of course. But where people can find more information to learn more about WEAP?

Jack

15:46

Thank you, JC. The starting point would be the WEAP website, which is WEAP21.org. It's got tutorials, videos, and a discussion forum with over 40,000 users and publications that have used WEAP. Over 900 publications are listed on the website, spanning the range from water quality to financial planning to climate change to reservoir, hydropower, energy and water. So all the different aspects of water planning, you'll find different publications that have looked at this in the research.

JC

16:17

That's great, thank you for these. All these links will be in the in the episode. Vishal, anything that you'd like to add?

Vishal

16:23

No, I think this is great. And I'm really happy that Jack could join us today, especially

because Jack is one of those very modest people. And he's built almost single-handedly one of the most effective water resources planning tools out there.

JC

16:39

Yes, I agree, Vishal. I agree this tool is perfect for planning more sustainable water. And sustainable water means a community, region, country that can be water self-sufficient. Jack, I would like to thank you for your time.

Jack

16:54

Thank you. Thank you, JC. I appreciate it.

JC

16:56

Thank you. Vishal, thank you so much. Until the next episode.

Vishal

17:01

Until then.

JC

17:02

Thank you so much, Vishal, and thank you so much, everyone. Don't forget to follow us on Spotify, Apple Podcasts and Google Podcasts. Stay tuned for our next episode.