The World's Water 2008-2009: The Biennial Report on Freshwater Resources (Report Launch)

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Woodrow Wilson International Center for Scholars

Edited Transcript—Peter Gleick

It's great to be back in the Woodrow Wilson Center. And let me start by thanking Geoff and the Center for hosting me again. We do this book every two years called *The World's Water*, and for the last three at least, the Woodrow Wilson Center has very kindly hosted, basically, the launch of the book. Also, before I start my presentation, I wanted to do something a little different this year. I've just come back from Davos. Davos was last week. Some of you know, at the World Economic Forum, they've been meeting for 20 years. It's an unusual group of people. It's CEOs, heads of state, the glitterati in many ways. And it's a bit of a strange environment. And for the last two years, they've taken on to some degree the issue of water. It's sort of been interesting to see how they think about water, or don't think about water, or should think about water, and I had the opportunity to go, and was in a series of -- I don't know if you know how Davos works, but there are public sessions in these rooms, and private sessions, and receptions, and really private -- I mean, God knows what's really going on in some of those rooms. But it all is circulated around rooms, and you sort of wonder what's going on in the next room. In order to prepare for Davos, we produced a video, which I'm going to show you, it's a four-minute video about water to try and help raise some understanding of some of the water issues. The version I'm going to show you, I guess we could call this the U.S. premiere, is the version that we showed in Davos last week to the Minister of Water for Singapore. I mean, it went to a lot -- a lot of people got to see it. There is going to be an edit that's going to be changed a little bit from what you're going to see now, but it'll give you a little bit of a sense of what we're doing. So in theory I can push a button and this is going to work.

[Video Plays]

Okay, thank you. What I'm going to do today is talk about some pieces of the world's water puzzle. For those of you who know the book, you know that every two years, the book addresses a different set of issues. There are chapters on major issues. There are little pieces

called water briefs that are shorter versions. There's a set of water data. This is the sixth volume. There were five previous ones, starting in 1998. This is the current one. Starting in 2002, I stopped doing it myself, when I realized it was unsustainable, and started to take advantage of the wonderful staff of the Pacific Institute who are now coauthors with me on various pieces of this, and I need to acknowledge my coauthors. I should also acknowledge the foreword was written my Malin Falkenmark, for those of you who know, a wonderful Swedish hydrologist who's been working on these issues for many, many years. And the Publisher is Island Press. And my editor is Todd Baldwin.

What's new in this volume is a chapter on peak water, which I'm going to go into a lot of detail on today. There's a chapter on water and climate. The institute has always done a lot of work on the impacts of climate change, of climate change on water resources, and we update that research in this. We're increasingly working, and this was relevant for the Davos crowd, on the connections between business and water. Businesses use a tremendous amount of water. They're beginning to think about their water footprint, if you will. They're beginning to integrate water into their planning and assess water related risks, some better than others. And at the same time, there's a $400 to $500 billion a year water business, selling water services, selling water equipment, selling water itself. And so we talk a little bit about those issues as well. There's a chapter on China and water, and I'm going to address China and water in my talk today. We talk about the Millennium Development Goals, the efforts to reduce poverty broadly, launched by the U.N. in the year 2000, and it's now halfway to the year 2015 which is the target date for the millennium development goals. And so there's a chapter that updates the status of the water related millennium development goals, to provide safe water and sanitation. And I'm not going to talk about that much, and the progress, just to give you a shorthand, has not been as good as it ought to have been. We talk about urban water efficiency as one of the solutions to urban water problems, focused mostly in this case on the United States, and efforts in the U.S. to improve the efficiency of water use. And there's some of these in briefs, these shorter pieces. There's one on the salt and sea, in some ways, the quintessential example of the conflict between agricultural use, urban water use, and the environment in the southern part of California. Tampa Bay's desalination plant; we wrote about it previously and we update the status of the Tampa Bay desalination plant. It's the largest desalination plant in the United States. It's now online after many years of delay and many millions of dollars over budget, but it is running. Three Gorges Dam, there's an update, the largest dam in the world in China. And each volume has a version of what we call the water conflict chronology. It's a chronology of water-related conflicts going back five thousand years, and we update it every year. It's updated online,

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but we update it on the print version as well. And then there are data. A whole set of data on all sorts of interesting aspects of water.

So, what I'm going to do is talk about the water crisis, what it is, very briefly. I'm going to talk about this issue of peak water, what we mean by it, how it might be relevant. I'm going to bring the context of peak water to China, and talk about the very difficult water challenges that China faces. And then I'm going to talk a little bit about solutions for the new century that we're in. That's what I'm going to do today.

So, briefly, what is the water crisis? Well, there are many pieces to it. The most significant in my mind has been, for many years, the failure to meet basic human needs for water. There are approximately a billion people worldwide without safe drinking water today. There are two and a half billion people worldwide without access to sanitation. Many of you have heard these numbers. We've made a little bit of progress in reducing the number of people without safe drinking water. We've been much less successful on the sanitation side. And that, I've said before, and I still think is inexcusable. It's not a question of money, it's not a question of technology, it's a question of governance, commitment, will, all of those things and that, in many ways, is the worst part of the world's water crisis.

The failure to meet basic human needs for water leads to water-related diseases. In the United States, in 1908, we started chlorinating our water supply. The first city in the United States happened to be Jersey City, chlorinated its water supply and cities around the country followed suit fairly rapidly. And if you look at the data, typhoid and diarrheal diseases in the United States went like this after we started chlorinating our water supply. We know how to solve, prevent water-related diseases, but we've not done it in the rest of the world, and the failure to meet basic human needs still leads to cholera, dysentery, typhoid, schistosomiasis, guinea worm, all of those things that you get when you don't have safe drinking water. And what's happening right now, today, as we speak, in Zimbabwe, the collapse of the government, associated with that the collapse of the water system, and a huge outbreak of cholera. Three thousand deaths is the current number that are even officially reported, and I don't know what the real numbers are, is an example of that.

Local water scarcity and resource depletion is a challenge in many parts of the world. Water contamination with human wastes and industrial wastes is a serious problem. The effects of climate change and extreme events; I'm not going to talk much about climate, although again, the institute's done a lot of work in this area, but the climate cycle is the hydrologic

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cycle: evaporation, condensation, formation of clouds, precipitation, runoff. That is the climate cycle, and as we change the climate, which we're already doing, we will see more and more evidence of impacts of climate change on our water systems, and water managers are not prepared for that. At the same time, there's a whole new interest in the connections between the energy required for water -- it takes a lot of energy to produce, and move, and treat, and use water -- and that has associated, of course, with greenhouse gas emissions. And so, the integration of energy policy and water policy, in part to deal with this issue of climate change, is a whole new exciting area of research and of policy in the water area.

Of course, we use water to produce food. Eighty percent of the world's water, 75 percent of the world's water goes to produce food. We also use water to produce every industrial good -- widgets generically, semiconductors, automobiles, clothing. And as tensions over water grow, as conflicts over water grow, the challenges to the production of food and goods and services also grows. Ecosystem degradation and destruction, some of the worst ecosystem collapses around the planet are associated with the fact that we're taking all of the water, or we're contaminating the water that ecosystems need. And I'm going to come back to this a little bit in the China context. And of course, politics. Water crosses borders. We've done a lot of work on water in conflict over the years. We've worked with the Woodrow Wilson Center and Geoff Dabelko in particular, on this issue of water and security. Increasingly, I think, sub-national conflicts are going to be of concern rather than international conflicts because, to some degree, the international community has a set of tools available for dealing with conflicts over water; less so at the sub-national level, and more and more of the examples in our water conflict chronology are not country A versus country B, they're ethnic group A versus ethnic group B, or regional conflicts, and that's a concern as well.

But I want to talk about peak water, this concept. It's the first chapter in the book, and I'm going to do it with some examples and some references to shapes. This is a shape that you're all familiar with, it's the exponential curve. It's the shape economists love to see on the assumption that somehow we should be able to get a three or a four or a 20 percent return in our financial systems every year, year after year, in an exponentially -- that's what Madoff was selling. And we see it in a lot of different forms, this exponential curve. This is global population from the year 1000 to the year 2000, and you see the exponential growth in population, globally. Gross national product; again, this is what economists loved to see in the U.S. from 1920 approximately, to about the year 2000. You can see it goes up and down a little bit, but mostly it goes up. And if it's not going up, we feel like we're in trouble. Global CO2 concentration from the year 1000 to the year 2000; you can really see the signal

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of the industrial revolution here. This is the climate problem in a single curve. It's that exponential growth in CO2.

So, here's another curve. Exponential growth, followed by a peak, followed by a decline in something, and we see this in all sorts of examples in our day to day lives and our national and international economy. And this is why we talk about peak oil. The debate about peak oil started many, many, many years ago with a guy named M. King Hubbert who proposed that we were going to see a peak of oil. He wrote about this, I think, in the 1960s. U.S. production of oil peaked in 1970. There it is. The big debate now about peak oil is when we're going to see a peak in global production of oil, not if. It's a nonrenewable resource. We will eventually reach a peak in global production. I don't want to get into a debate about that, but that's what this is about. And here's the curve for oil.

Here's the Dow Jones Industrial Average from 2002 to 2009, through the end of January. That's an ugly curve, isn't it? Here's herring catch; in theory, a renewable resource, fishers' resource, and similarly, Atlantic cod from 1950 to 2008, showing the peak in the production, our ability to harvest what was a renewable resource -- in theory, still is a renewable resource, if fishing pressure decreases. But, again, you can see these kinds of curves in our day to day lives, reflected in resource use, in our financial systems, our economies, in our daily lives.

This is called the logistics curve. For mathematicians, it's exponential increase followed by a leveling off, and then a leveling, a constant something over time. Here is U.S. market penetration of telephones in the United States. Exponential growth, except for the depression and World War II, but increased, and then leveling off as basically everybody had a telephone. And if you look at the same kinds of technological curves for VCRs and CD players and mobile telephones, they all follow this sort of exponential ramping up of demand, and then a leveling off as consumption gets satisfied. Now, sometimes they go down again when a technology disappears and is replaced. I think if you looked at the phonograph in our homes and some of those things, you would see a decline.

Here is total U.S. water withdrawals: exponential growth followed by a peak around 1975 or 1980, followed by a leveling off. And this is something in the water world that most people don't know, although I talk about it a lot, so if you've heard me talk about it -- if you've heard me talk, you've probably heard me talk about it. We have actually leveled off our use of water in the United States. We use less water in the United States today for everything

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than we used in 1980. On a per capita basis, we use a lot less, and we've seen this leveling off. It's not true globally, but it's true in the United States.

So, let me talk a little bit about peak oil and peak water together, with some discussion about the characteristics of oil and water. In terms of quantity, oil is a finite resource. There's a certain amount of oil on the planet, and it's finite. It's not growing except incredibly slowly from a human point of view. Oil was laid down over millennia, over eons really, from the decay of carbon materials. Water is also, literally, a finite resource. There's a fixed amount of water on the planet and we're not getting any more and we're not really losing any either. People like to say the same amount of water on the planet in the dinosaurs is the same amount of water we have today. But, from the human point of view, essentially, oil is an unlimited resource because of the vast amount of water that's in the oceans that could be desalinated, could be turned into a resource that we could use, at a cost. Oil is a nonrenewable resource. Water is a renewable resource, although I'm going to come back to this in a minute, with locally nonrenewable stocks. Not all water resources are renewable.

Transportability; we move oil all over the world. It's very valuable. A tanker full of oil is worth a lot of money. A tanker full of water is not worth a lot of money. And so, we do transport water a few thousand kilometers in pipelines, and sometimes, under extreme circumstances by tanker. But effectively, water is not transportable very far. It's just not economically viable. We will never transport water from the Great Lakes to Asia. We will never transport water from Norway to South America or South Africa. It's just too far. Long before we do that, we will desalinate. Because desalination ultimately will be cheaper than once you get a couple thousand miles of diesel power pushing a tanker or bags through the ocean.

Substitutability; there are lots of alternatives for oil. And this is the debate going on worldwide now, in the climate context, in the energy security context; there are substitutes for the things we use oil for. There are no substitutes for most of the things we use water for. You can't grow food without water.

Now, let me talk a little bit more about this renewable versus nonrenewable issue. There are a lot of ways to define this but people get confused. One way to think about this is that nonrenewable resources are stock limited. There's a fixed amount of them. There's a stock, and when you use it up, or use up the economically accessible resource, that's it. Renewable resources tend to be flow limited. You can use them over and over again. The amount of

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water I use this year from a river doesn't affect the amount of water I'm going to get next year in the river. But they're flow limited. I can't use more water than the river provides. I can't use more solar than actually strikes the planet -- unless I build satellites and go try and collect more. So, there's a flow limit to a lot of renewable resources. Water, uniquely, exhibits characteristics of both stock and flow resources. And this is going to be key to a lot of the policy debates that we have.

So, let me talk about peak renewable water. In theory, peak renewable water follows the logistic curve. We can increase our use of it up to the limit of what's available in the flow resource. In theory, we could use all of the renewable resource. Now, in practice, we really can't. There are questions about ecological impacts of using water, the economic costs of getting it. A lot of the renewable water on the planet is inaccessible. It's in rivers that flow north in Siberia and empty into the Arctic. And, admittedly, the Soviets for a long time thought about building big projects to capture that water and divert it south to where they needed it. We build projects to make more and more of the renewable resource available to us, but it's not all really available to us. So, the actual amount of water we can use of the total renewable supply is less than the total. It's somewhat below that peak.

But, there is nonrenewable water as well. A lot of the water we use is in what's called fossil aquifers, fossil groundwater. It was laid down, not unlike oil, over millennia; thousands, tens of thousands of years. We see it in very dry areas that are vast quantities of groundwater in northern Chad and in Libya that the Libyans are tapping now for coastal use in the central valley, and parts of India, and parts of the North China Plain. When we use water faster than it's naturally recharged, it's non-sustainable. And, it will follow this curve. We'll use it, and then it'll become increasingly hard to get. From an economic point of view, from a technological point of view, and we will have peak nonrenewable water. There's, by some estimates, as much as 30 or 40 percent of the agricultural production today, worldwide, comes from nonrenewable water resources. Which means it's going to get more expensive to pump, and ultimately a lot of those resources are going to go out of production. That's a real challenge from a food point of view, especially in a world that is going from six and a half to seven billion to nine billion people, and we want to grow more food, not less.

But I also want to introduce another concept, something we call peak ecological water. I'm going to draw a quick graph here. The Y-axis, the vertical axis, is the value provided by water. The X-axis is the amount of water humans use. So, at the simplest level, the more water we use, humans, the more value we get, the more food we grow, the more

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semiconductors we can make, the more things we can do. It may not be linear, it may be exponential, it may go up, it may go down, but in theory, economists tell us, the more water we use, the more value humans get out of it, and that's pretty straightforward. The problem is, the more water we use, the more ecological value, in a sense, we remove. We're taking water away from ecosystems, and the value that ecosystems get out of that same water obviously declines as humans take more and more water. And so part of the question is, what happens in this middle area? Where do these curves cross? What does that really mean? And another way to look at it is if we -- again, the X-axis is the total amount of water that humans use. The Y-axis is now the total value from using water, ecological value and human value. And it follows this kind of a curve. At some point, we reach the peak where the additional unit of water we use causes more ecological damage than it provides human benefit. And the total value of using more water starts to decline. We're very bad at measuring, certainly, the ecological value, either to humans or just the ecological value of fisheries and wetlands, of the purification process of natural water systems, so it's very hard to determine these kinds of values, to put numbers on these axes. But the idea that there is a point, beyond which, for different kinds of ecosystems and different kinds of water systems, we can approach and reach and exceed peak ecological value, I think, is indisputable. And this is the debate that's beginning to go on in the water world now, about peak ecological value.

So, what does peak water mean? It doesn't mean we're going to run out of water. We're never going to run out of water. Water is mostly a renewable resource. There is a lot of water in the oceans that we never are going to tap, even as we tap more and more of the oceans. Where water is nonrenewable, we will run into stock constraints. And more and more around the world, the problems that we see around water are stock constraints on water, where we're using water non-renewably. And, we are going to run up against flow limits on the renewable side that are a combination of economic and ecological. Economic because it's become more and more expensive and we can no longer tap a renewable resource. It's too expensive to divert those Siberian rivers. It's too expensive to move water from Alaska to Mexico, as they proposed in the 1960s with the famous NAWAPA project. Or, the limits are ecological, and we can no longer use more of a resource because of the ecological damage that it causes. And that's the debate that we're having in Florida about the Everglades; or the Central Valley of California with the Sacramento San Joaquin River, and the increasing risk that we're going to drive the salmon stocks to extinction; or the Ural Sea, where the 24 species of fish endemic only to the Ural Sea are now extinct. Those are

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ecological exceedances. Those are places where we've exceeded peak ecological water. And that's a challenge, more and more, around the world.

So, let me talk about China, because China is an example where all of these problems come together in probably the worst way on the planet. All of the water crisis examples I gave, all of this issue of peak water. China's had a remarkable series of economic years. The growth in China's economy over the last couple of decades has been unbelievable. But it's come at an enormous environmental cost to them, to their air quality, to human health, and especially to water resources. China's water resources are over allocated, they're inefficiently used, and they're grossly polluted by human waste, sewage, and by industrial wastes. They're suffering from both peak water in the limits to availability, and peak ecological water. And there are many solutions and many opportunities for the Chinese to solve their water problems, to sustainably manage the water that they have. But change is very slow in coming. There's a growing awareness in China of these challenges, which I'll show shortly, but the change is happening very slowly.

So, some of their problems are associated with exponential growth. We're already seeing, and Chinese scientists have been remarkably forthcoming in researching and describing impacts of climate change on their water resources. Their groundwater quality is increasingly, and exponentially, being degraded by the massive dumping of industrial wastes and untreated or partially treated sewage. It's contaminating their groundwater aquifers. Desertification in northern China is increasing rapidly because of the excessive withdrawal of surface water and groundwater that's drying up desert ecosystems, drying up the rivers and streams that flow in these regions, and by deforestation, which is contributing to this as well. And, increasingly, we're seeing a remarkable growth in dissent, if you will, internal dissent and conflict, public protests, over water problems, over water quality, over water allocations. By some estimates, there were 50,000 protests in the last couple of years in China over environmental issues. The large majority of which were water. There is a growing NGO public movement about, in China, on environmental issues and particularly over water issues. Some of their problems are peak problems. A substantial portion of their agricultural production relies on unsustainable water pumping, from the North China Plain in particular, around Beijing. And some of their agricultural production is coming out of production because of that. In parts of northern China, villages are having to dig groundwater wells that are 100 meters or 200 meters, 600 feet deep, when just a few decades ago, their wells were 20 to 30 meters deep. That's a huge economic burden on villages that they often can't afford. But the groundwater is just dropping, dropping, dropping.

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On the business side, companies are canceling ventures in China because of water concerns. They can't get the water quality they need, or they can't get reliable water quantity. And, in fact, the Chinese themselves are putting limits on certain kinds of licenses that they're issuing for water intensive business in northern China because the water isn't available on a reliable basis. Pharmaceutical companies, companies that need very high quality input water, semiconductor manufacturers that need very high quality input water, are choosing to cancel projects in China because the quality of water is so bad that the upfront economic cost of building the pretreatment systems is sufficiently high to make them basically build their plant somewhere else.

Chinese scientists are noting worsening health problems associated with a whole series of environmental issues but including water contamination. There are new cancer clusters being discovered that Chinese scientists are attributing to industrial water pollution. And there are peak ecological issues in China. Eighty percent of the wetlands in the North China Plain have dried up. Natural streams and creeks have dried up because of over pumping of ground water that recharges these streams. Major species are being driven to extinction or have been driven to extinction because of infrastructure projects that the Chinese have built. I think in the next few years, the Yangtze River dolphin will go extinct because of Three Gorges Dam and the other dams along the Yangtze River, and there are many other examples.

Productivity in the East China Sea is dropping, ocean productivity of fisheries, because a lot of the sediments that used to recharge those, that used to provide and nourish those fisheries, those sediments are now being trapped in upstream dams. Three Gorges Dam is now online. It's a huge sediment trap. And Chinese scientists, again, have observed the diminished flows of sediments into the East China Sea and they're observing decreases in fisheries' productivity because of those water projects. It's a peak ecological water problem. There are lots of horrible pictures from China.

And the Chinese are aware of this. This is a statement from a member of their Academy of Sciences, "There will be no sustainable development in the future if there is no groundwater supply." The realization that their economy ultimately depends on water has sunk in, and they understand it. The China Daily said, "The pursuit of economic growth," this was an editorial, "The pursuit of economic growth has been the priority overshadowing the vital issues of water resources and ecological balance." And, in 2007, President Hu Jintao called

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for "Securing more clean water, drinking water, improving water conservation, water pollution prevention, restricting excessive water resource exploitation, and cutting water waste." A remarkable statement of water policy from a national leader.

I can't tell you the unbelievable buzz that President Obama got when he put the words clean water in the inaugural address. That was it, he said "We need to pursue clean water," and that's all he said about water, but we were really excited to hear it.

You know, we all look for these keywords, but something like this would have been unbelievable, and to hear the president of China say that is at least an indication, at the political level, how seriously they understand the nature of their water problem, if not that they're taking enough steps to address it yet.

So, moving towards solutions; these apply not just to China, but to everybody. We need to think about developing water supply, which is what we've done always in the 20th century, but to different standards. A lot of the infrastructure that we built has brought enormous benefits to us, but serious ecological costs as well that were not fully understood in the 20th century. And so, 21st century water supply has got to mean something a little different than 20th century water supply. It means ecological considerations have to be addressed; community considerations have to be addressed. We have to rethink the idea of cost-benefit in a different way. We need to expand our notion of supply, not just to mean tapping virgin untapped waters, but reusing wastewater. That's a source of supply that increasingly we're looking to, to meet certain kinds of needs, but it didn't meet the definition of supply in the 20th century.

We need to expand and improve infrastructure in many parts of the world. Many parts of the world, especially in developing countries, need new water infrastructure. In the richer countries, we need to reinvest in our infrastructure. But I would like to push pretty hard the idea that we need to redefine infrastructure. If we're going to spend 100 billion dollars in the United States on stimulus, on water infrastructure, I would like to see that money spent on low-flow toilets, and efficient washing machines, efficient drip irrigation systems in agriculture, not just building dams or centralized waste water treatment plants, or piping. Those things need to be invested in as well, but we need to redefine infrastructure to mean something different than it meant in the 20th century.

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Associated with this is the idea of improving water use efficiency. Not just supply, this issue of demand. How do we use water? Let's do more with the water we've already spent a lot of money developing. And, again, those of you who have heard me talk know that I like to talk about water use efficiency. We can grow more food with less water. We can flush our toilets and wash our clothes with less water. We spent a lot of money treating water to a very high standard in the United States to produce potable water, and then we use it to flush our toilets in six gallon per flush toilets, when we could be using it in 1.1 gallons per flush toilets, or better yet, not using potable water to flush our toilets. All of those things need to be addressed in tackling solutions. Stricter standards for water quality; in the United States, we have the Clean Water Act and the Safe Drinking Water Act, two foundational water laws that protect our drinking water and our water supplies from industrial contamination. They were signed into law a long time ago, and there have been some modifications since then, but it's long past time that we brought those two laws into the 21st century. We need to rethink the Clean Water Act and the Safe Drinking Water Act.

We need to enforce the standards we have. The Chinese need to enforce the standards they have. They have standards, but they're not enforced. In China, there's a serious mismatch between the national level and the provincial level and there are political disputes there. And we have them between the federal level and the state level and local levels as well. But, the truth is, we have pretty good standards for a lot of things, and we have pretty bad enforcement for a number of things. And I could talk about bottled water, I could talk about tap water, I could talk about discharges from industrial areas as well.

Economics is key to this. There are plenty of places around the world where we don't price water properly. The Chinese are changing their pricing structures for water; pretty remarkable how rapidly they're moving to market solutions for certain kinds of things. In some places, we do price water, but not properly or not adequately, and in some places we don't price water at all. Let's use proper pricing and markets, with the understanding -- and this is a debate we have in the water world -- that water is also a human right, and that in places where people can't afford to pay for water for basic needs, the issue isn't pricing, the issue is access. And it should be subsidized for those purposes. We need to improve and expand public participation in the water sector, and the Chinese need to improve and expand public participation in the water sector. And they're moving very slowly in that direction, but they could move more quickly, as could the rest of us. There is a new law in China that encourages public participation in environmental decision-making. It's sort of their environmental impact assessment program. In fact, their law is on environmental impact

ONE WOODROW WILSON PLAZA, 1300 PENNSYLVANIA AVENUE, NW, WASHINGTON DC 20004-3027 T 202.691.4000 F 202.691.4001
E-MAIL: ECSP@WILSONCENTER.ORG WEB: WWW.WILSONCENTER.ORG/ECSP

assessment, and it says there will be public participation in reviews in environmental impact assessments. It's quite remarkable. But it hasn't been as enforced to the extent it should be.

And ultimately, none of this works very well if our institutions are weak. We have a lot of different institutions. In China, there are 12 or 13 institutions at the national level alone that deal with water. In the United States, it's 18 or 19. We have the FDA that regulates bottled water, EPA regulates drinking water; Commerce and NOA, which does research on climate change and water; Interior, which manages the bureau of reclamation and some of the dams; and the army corps of engineers; and the state department that does international foreign policy associated with economic development and water. I could go on and on. We don't coordinate our institutions very well. And one could also argue that within our institutions, management over water issues could be better. And not all water is national. A lot of water is very local. So, how do the national organizations work with the state organizations or the local organizations? We could do a lot to fix our water institutions.

In China, water laws are outdated and they're weak and they're inadequately enforced. I've mentioned this already, there are conflicts between national and provincial powers. There's little input from nongovernmental sources in China. Polluters face vague penalties. There are laws on the books for penalizing polluters, but the penalties are vague. Agencies' responsibilities and authorities conflict across different agencies. There is a heavy reliance on supply as the answer to China's water problems, rather than demand. And so we see the Three Gorges Dam being built, now it's finished, the biggest dam in the world. We see the South-North canal to move water from the southern part of the country to the northern part of the country, what will be the world's biggest water transfer system ever, if they finish it, at the cost of 30 or 40 or 50 billion dollars and untold ecological damage. They still have a supply focus in their policies. Pricing and market mechanisms are rare and inadequately applied in China.

Okay. There is a real water crisis. It's in different forms in different regions. We'll never run out of water, but we're past the point of peak water and peak ecological water in many regions and China's not alone. Excessive use of water or inadequate supply, is already constraining industrial production and growth in some regions and sectors. And to some degree, just to circle around here, this is what Davos was interested in. I don't know if they care about ecological water as much as they ought to. I don't know if they care about the human right to water as much as they ought to. But in places where industrial production is increasingly constrained by water quality problems, or availability of water, or water rights

ONE WOODROW WILSON PLAZA, 1300 PENNSYLVANIA AVENUE, NW, WASHINGTON DC 20004-3027 T 202.691.4000 F 202.691.4001
E-MAIL: ECSP@WILSONCENTER.ORG WEB: WWW.WILSONCENTER.ORG/ECSP

disputes, or conflicts over water, all of a sudden, they're interested. Coca-Cola, which I'm going to argue has one of the best corporate water programs in the world today, didn't always. And one of the reasons why they've stepped up, in my mind, and started to address water issues is because they ran into very serious problems in India. They lost the license to operate for some of their bottled water plants. They were discharging waste without adequate treatment. There were serious water problems -- and there still are, I don't want to minimize that -- but they've thought, more than many other corporations now, about what water means, and they're trying to deal with it, much more so than many other companies. There's very uneven response to this, but it's a growing issue.

There are lots of opportunities for solutions, and I've described some of them, but they're going to require new technology or better applications of old technology, new institutions or better functioning of old institutions. In the end, truly sustainable water management and use requires efficiency, smart economics, advanced technology, and better governance and water management. What we want to do is we want to move from this, to this. Thank you very much.

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E-MAIL: ECSP@WILSONCENTER.ORG WEB: WWW.WILSONCENTER.ORG/ECSP