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WATER: ASIA'S NEW BATTLEGROUND?

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P R O C E E D I N G S

MR. STUMPF: Thank you. My name is Matt Stumpf and I'm the director of the Washington Office of Asia Society. Thank you very much for joining us today. I'm particularly pleased that you all could be here for a joint event of Asia Society and the India Project at the Brookings Institution. The Asia Society, as many of you know, has transformed its presence here in Washington to do more here to build cooperation between the United States and Asia. We continue our long-held convening role with events like these, but we've expanded our work in researching and developing new ideas for cooperation among Asia-Pacific nations and in making the public case for these new ideas in Washington, Beijing, Delhi, and beyond.

Our co-organizers and hosts today at the India Project continue to leverage the Brookings Institution's multidisciplinary expertise to examine critical policy challenges and opportunities related to India, as well as U.S.-India relations. The India Project's next public event will be on February 14th, when a panel will discuss recent political developments in India.

Today, in addition to discussing key economic, political, and security challenge for India and Asia more broadly, as you can tell maybe from the cookies, we're here today to celebrate a little bit. Today's event follows another Asia Society event held yesterday in New York to celebrate Brahma Chellaney's *Water: Asia's New Battleground* for its selection as the winner of the 2012 Asia Society Bernard Schwartz Book Award. The Bernard Schwartz Book Award is the only award that recognizes nonfiction books for their outstanding contributions to the understanding of contemporary Asia or U.S.-Asia relations, as well as potential policy impacts relating to the region. The book was chosen as winner from nearly 100 nominations by a jury co-chaired by Carol Gluck of Columbia University and Tommy Koh, Singapore's Ambassador-at-Large, and made up of leading

experts from the policy world, academia, and the media world from across the Asia Pacific.

This book, *Water*, falls in the great tradition of our previous winners -- *The Party*, by Richard McGregor; *The Art of Not Being Governed: An Anarchist History of Upland Southeast Asia* by James Scott; and the first winner, *Tearing Apart the Land: Islam and Legitimacy in Southern Thailand* by Duncan McCargo. We'd like to thank Bernard Schwartz for supporting this award and today's event.

This book studies in-depth the issue that we're here today to discuss. As our panelists will describe, national decisions and successes or failures in building international cooperation on these issues in Asia will have a massive impact in shaping economics and security in the region. As Dr. Chellaney points out in *Water*, Tibetan rivers are the lifeblood of the world's two most populous nations, China and India, and the other countries that stretch from Afghanistan to Vietnam in a contiguous arc. Together these countries make up 46.3 percent of the world's population.

Our panelists today are Brahma Chellaney, Jennifer Turner, and our moderator, Tanvi Madan. Jennifer, and then Brahma will each offer their insights one by one at the podium and then we'll have a moderated conversation with Tanvi. We'll end with time for your questions.

You have the bios at your seat, so we'll move right to the program. Please welcome Jennifer Turner.

(Applause)

MS. TURNER: Hi there. Thanks so much for coming. We're waiting for the slides to come up because mine are mainly me pictures, so don't be afraid. They're just going to be here. They'll be here to -- oh, good. Awesome.

All right. Well, Choke. Some of you in the room know a little bit about

my work at the Wilson Center on *Choke Point China*. Well, we're going global, you guys. With my colleagues at Circle of Blue, a Michigan-based NGO that does multimedia reporting on the global freshwater crisis, they started doing a Choke Point U.S. examination, looking at how energy development was impacting water. We've been doing China, and we're moving on to India. But we just started India, so I'll just give you a little glimpse of that one.

So I'm a little different than Brahma. He's macro man here today. And so I'm only doing micro, focusing on the two most populated countries in the world and the question of water. But I want you to know that, you know, when you think about China today in the news, most of you all are focused on Beijing's grey skies; correct? And you know that the big driver of some of this pollution is coal. But the story of coal in China also has an impact on water. And, in fact, water is China's -- it's their biggest environmental challenge, and a challenge both in terms of shortages and pollution that really could undermine its economic growth.

Just for one slide on background here, you know, the water quality in China, while they have been strengthening their laws over the years, that still over the past 10 years the numbers remain about the same in terms of 300 million people lack access to clean water and about 30 percent of the water is the lowest three grades -- 4, 5, and 5+ -- which means it shouldn't really be used for anything. So in some ways, water quality is the poster child of failed environmental governance in China.

But I'm here today to talk to you not about the water quality, but keep that in the back of your mind because it's one of the big stressors on China's water. A big stressor that hadn't really gotten much attention, you know, this sounds rather conceited here but so Circle of Blue and China Environment Farm, we started two years ago doing on-the-ground research and reporting on how energy development was

impacting water. And I have a pretty extensive network in China and I do water and I have my energy people here. Well, I kind of -- like a Reese's Peanut Butter Cup, trying to bring these two sides together. And we went to China asking questions of government, business, NGOs, and researchers. How is energy development impacting water? And people were so receptive. In fact, I sent the Circle of Blue folks to China and they got into coal-fired power plants, coal-to-liquid plants, had interviews with people that I didn't even know. The network caught on fire.

They also got inside here. And I do this at most talks. If you've been to my talk before you can't answer. But where is -- they got inside this place. Who knows where this is?

Don't be shy. We do shout-outs at the Wilson Center.

Yeah?

SPEAKER: The Water Transfer Project.

MS. TURNER: Yes. Gold star for the back of the room there. This is the South-North Water Transfer Project, which is the largest water transfer project in the world, and it's okay if you hadn't heard about it. Really. It's okay.

But when we went to China, we got an interview with the chief engineer of the South-North Water Transfer Project. I was thinking more it's about moving water and the energy footprint of this water, but you know, we asked about this western line. The eastern one is built. You know, again, moving water from southern China to dry north, which is very dry; only 20 percent of the rain falls there. Middle one will come online moving the water in 2014. But the western line, very difficult to build. Goes through mountains. Very expensive. It's going to take 15 years. And he told us -- he said, "We must build this line because this western line is going to get us up to Xinjiang where we can get water to the coal fields and mine the coal."

North China is coal country, you guys. They've got -- don't have water but they've got a lot of coal. And so clearly, the water energy confrontation, you know, when we were starting to do our research it started becoming clearer to us. China is going to move water to get it to the coal. But how much water? What is coal's water footprint in China?

Well, we talked to the water experts, talked to the energy experts. Using Chinese data, we estimate that 20 percent of China's water is going just for the coal sector. And that's the whole lifecycle of coal. And, you know, maybe it wasn't the best data because we're foreigners coming in looking at it, but it still was quite high. And this has gotten a lot of attention from my colleagues in China. And in fact, now I'm getting a lot of inquires, "So what do we do?" Right? This is a big problem and it's only going to grow. How's it going to grow?

My apologies. Pie chart. Only one.

China's energy -- electricity use right now, 70 percent of that pie is coal. So even though you may have heard that China's doing this massive green energy revolution – coal, hydro -- we can argue about hydro being green later -- but they're doing -- I'm sorry -- wind, solar, hydro, nuclear -- still a very small piece of the pie. And using Chinese numbers, in 2020, coal use is going to double, and if it doubles, it means it needs more water.

So coal appears to remain the king in China. And this is important for you to think about, you know, water security in China. You know the water -- there's already pressures on it. Ag uses 60 percent, the cities are growing, but it's those cities that are driving this energy need -- the cement, the steel, the consumption in the cities. And coal is there and they can get to it if they can get the water.

And so their plans are they've got this plan to build these coal bases.

Coal bases. We have a story. Just so you know, the Choke Point China website, you can read stories about one coal base in Ningdong in Ningxia Province. Huge, 50,000 workers. And what these coal bases have is coal-to-liquid plants, coal-to-chemicals, and giant coal-fired power plants at the mouth of the mines to use transmission lines to move it out. And right now there's just one really big one and a couple of others developing, but the 12-5-year plan, all those little dots there, it's not blue chicken pox. These are coal bases that are planned in the next five years.

Now, look at the colors in the background. That's the rainfall. You can guess from the red. Red means very little. So where most of the coal bases are, it is somewhere from like 200 to 600 millimeters a year; there is no water. So where are they going to get it? Remember, the South-North Water Transfer Project.

My running joke is Chinese engineers, they've got a tattoo. It says, "Nothing is too big. We will move this water if we need to." Also pondering whether or not to use desal. Desalination plants in Bohai Bay to desalinate the water so nuclear plants to desalinate the water to move that water to inner Mongolia to mine coal. And if that works, let's keep it going and go out to Xinjiang.

But keep in the back of your mind there the energy footprint of desalinating and also moving this is huge. And we haven't yet found -- our research has catalyzed a handful of researchers in China to start asking this question. I believe that the water sector is actually a very high energy sector in China but no one has noticed yet. So I'm trying to make them notice. That sounds bad; make them notice. I'd like them to notice.

Now, another kind of ripple effect from the coal needs water is north central China, it's been a grain belt for decades -- centuries -- well, decades, where about 50 percent of the wheat is growing. Well, Ag is losing out. And this story we could tell in

very country, even the United States. Energy moves in; ag moves out.

So we have a new story out about the Ministry of Water Resources doing massive investments in northeast China to promote agriculture, but then that could eventually lead to yet more stressors on that environment.

This is a slide to say I'm not going to talk about dams, but I'm going to talk about dams, simply to note though that southern China for the past 2-1/2 years has had five major droughts. This is in the same basins that China wants to move water north; the same basins where they're damning it like bejeebers. That's Brahma's bailiwick in a few minute.

Coal is king, dams are queen, the new prince perhaps of energy in China is shale gas. China is actually -- they've done about 100 test fracking wells in China, mainly Sichuan province. Later on, look at Brahma's slides. Where are all those dams going in? A lot of them in Sichuan province. A lot of pressures on the water and what's supposed to be a water-rich province but coming down also by adding shale gas to it.

This photo is actually from -- when Circle of Blue was in China about five months ago they were standing on a highway looking down at a fracking well and some of these Petro China guys came up to chat with our Circle of Blue folks and suddenly this farmer came out and started yelling at Petro China saying that the shale gas well had caused his fish to die and his land wasn't producing as much. I mean, I'm just flagging this for you because, you know, shale is kind of a hot topic in the States. And while it's still -- it's nowhere near anywhere near commercial stage in China. There's a lot of the wells happening, but there's not yet any kind of -- well, there's a water pollution control law but there's really not specific regulations that could protect China's groundwater to this kind of pollution.

Now, I'm not all gloom and doom. Do I seem gloom and doom? Okay.

Just looking for nods out in the audience. Just checking.

There's actually in China, we did see, you know, in talking to people they are awakening to some of these choke points. On the left we have a coal-to-liquids plant. It's the world's largest coal-to-liquids plant because China doesn't want to become dependent on overseas oil. They've got coal. We could make oil out of coal; right? Well, this is very, very water-intensive. This plant is in Ordos, inner Mongolia, where there's not a lot of water. Once this came online a couple years ago, the National Development Reform Commission put brakes on, at least temporarily, on more plants because again, the water footprint is huge and the energy footprint. Maybe not the most energy and water efficient way to get oil, but again, the pressure in China is energy security. But those of us, you know, Brahma and I are thinking, you know, energy security, but at the expense of water, security. Big question. On the right though.

This is from the inside of an ultra super critical coal-fired power plant. China's building the world's most efficient coal-fired power plants using air cooling. And that's really good news on the water footprint front; right? More efficient on water and coal; good all around. The challenge is that China still is building lots of coal-fired power plants, needs lots of coal, still only washing about half of it. So a lot of the emissions that come out of these albeit efficient plants, still causing a lot of pollution problems.

I want to let you know, too, that on the waterfront, the Ministry of Water Resources, you know, using their strong power, when party states have this benefit, really has promoted aggressive water allocation scheme on the Yellow River. Back in 1998, the water from the Yellow River didn't make it to the ocean, so they now are very strict on allocating every province and the province going down the line. So really trying to push more water efficiencies.

But still overall in China, their industries are some of the most wasteful in

terms of water use, 12-5 year plan is trying to address that by demanding that 30 percent water recycling. A lot of water leaks out in agriculture, irrigation. This is just a start and it's the only basin where there has been some kind of water allocation. But again, very top-down and a lot of inefficiencies.

When we went to China, we also talked to a lot of city officials. "Hey, what are you guys doing on being more efficient with your water?" Because again, a lot of pressure from industry and ag and coal. What are the cities doing? Well, Beijing, so far from what I can find, is the only city that has a rather aggressive plan to recycle water in the inner city and to use it to create more gray water for flushing toilets and landscape.

And this isn't horribly sexy to talk about but it's very important. I mean, China is an incredibly water-constrained country and Brahma, he's going to show you some nice stats about just how water constrained are they.

Okay. Another solution for China. They have water constraints on coal. They're trying to address them through high-tech, you know, through building all these water transfers and mining the bajeebees out of the North China. But they still have transport gridlocks. So one option that China's been expanding on has been to import more coal. This is from Australia, and Australia, we have a couple stories online about Choke Point Australia, how in order to address China's coal imports needs, Australia has been mining a lot more but it's also putting pressures on Australia's own agricultural development.

China is also importing more coal from the United States. Shale gas has undermined a lot of our coal industry, so what does a coal company do in the United States? We're shipping coal to China. It's not yet going from our ports; it's going out through British Columbia. Another debate that you'll probably hear coming down the line here. A lot of environmentalists don't want Washington and Oregon to do deepwater

ports. And the reason I bring this up, again, by importing coal, China is ostensibly importing water -- virtual water imports. There's also you could think about China's increased agricultural imports. Again, lack of water; you can import it.

Now, here I'm just doing -- it's kind of like a movie trailer. See, Choke Point China, we've been doing it for two years and we've done mainly research and reporting. And I'm actually in the process -- I'm putting together a team of four U.S. and four Chinese water and energy experts. I'm calling them the China Water Energy Team or China WET, and we're going to China in April to start talking about some of these water energy confrontations that we've seen to try to get more of a dialogue going in China about what should be China's policy and research priorities, where the role of NGOs fit in on the water energy nexus.

So in one of our recent grants we've also had a chance to start an exploration of India, looking at the water energy confrontations there. And I have to admit, I'm still really new at India, but you know, there are some interesting stories that we just found -- my colleagues just came back from India just a couple weeks ago and so we haven't even started publishing the story. So this is, like I said, kind of a movie trailer for you here.

But in India, there's a water food energy cycle of risk. As you probably know, in India, the government, you know, very similar to China, kind of owns and operates the energy supply, transportation infrastructure, and in India in particular they heavily subsidize energy and farm production. So what we found, my colleagues, they went to -- they were up in Punjab and, you know, they saw that for the farmers there's a lot of free energy and free water, subsidized farm inputs. So India really is producing lots of grain. In fact, they've got 62 metric tons of surplus rice right now.

But in Punjab there's this kind of cycle of risk because when farmers are

given free energy and free water, well, they're going to use it; right? You want to sell your stuff. You want to produce grain. And the challenge though is that the water tables are dropping a lot up in Punjab and the neighboring states. So what do you do? Well, you've got free energy so you can install more tube wells. I mean, India, we've got a lot of stats. Tube wells, it's going off the roof how many they're putting in. So the water tables are falling. And then this is the same region where climate change is having a drying effect, but it's okay. You know, we've got free energy. We can keep going after it.

But this energy in India, in Punjab, about 30 to 40 percent of the electricity actually goes to agriculture, and that's very different from China. We don't have -- that's not the stats we have there. And so you have this kind of cycle because they're burning a lot more coal to get at the water to serve the food. And in part of the trip they also went down to Chhattisgarh in East Central India, which is the second largest coal-producing and largest coal-consuming state. Just this one -- this is the largest coal pit in Asia evidently. They told us that. You never know for sure. We're going to double-check. But it produces 30-plus million metric tons per year, which is about 1-1/2 times what the entire state of Ohio produces.

Coal is making up about 42 percent of total energy use; 80 percent of their electricity. And the electricity sector, you know, it's growing. Some of it, you know, from the urbanization, but agriculture, again, has a big footprint in the energy sector. And so one thing that they found is that kind of like in China, you've got coal-fired power plants kind of as we say in Chinese, sprouting like bamboo shoots after the rain. And this is not a South-North Water Transfer Project scale, but through Chhattisgarh where a lot of this coal is, they're building these water diversion projects because they need to get more water to cool the coal-fired power plants to wash the coal. India actually does wash almost all of its coal, which is good news on the pollution front, but still it's an example of

how water is serving energy as well.

I have to kind of apologize because I don't have too much more of the story to tell but in the second week of February we'll be starting to launch about four stories and we'll be going back to India hopefully later in the year and try, you know, the model that we're doing with Choke Point is trying to go out, do massive data grabs, talk to people, and then the Wilson Center, we're going to be starting to do more convening. So I'm going to give my time to Brahma. Is that okay? Thank you.

(Applause)

MR. CHELLANEY: Thank you. My presentation will focus on the factors behind Asia's water crisis and the possible crisis mitigation measures possible in the Asian context. Because of the broad scope of my subject, I should warn you beforehand that mine will be a rush presentation. I've been given 20 minutes. I have a lot of ground to cover so I'm going to make my points telegraphically.

Of all the natural resources on which the modern world depends, water is the most critical. Water is essential to produce electricity, to mine coal and uranium, and to refine oil and gas. Water is essential to produce virtually all the goods that we find in the marketplace. There are substitutes for oil but there is no substitute for water. Yet, water is the world's most underappreciated and undervalued commodity. Asia's water crisis is assuming such critical proportions that without mitigating this crisis, Asia's continued economic growth will not be possible because water scarcity and rapid economic growth cannot go hand in hand. And how Asia manages its water crisis will very much shape its security and economic future.

Asia is guzzling and polluting its water resources at an ever-growing rate, despite the fact that it is the driest continent in the world. It has less than one-tenth of the water resources per capita of South America or Australia and New Zealand; less than

one-fourth of North America; one-third of Europe; and 25 percent less than Africa. Yet, the world's fastest growing demand for water for industrial and food production and for municipal supply is in Asia, the locomotive of the world economy. The question is can Asia remain the locomotive of the world economy without addressing its water crisis?

The water situation is particularly grim in Asia's most densely populated regions. East Asia and South Asia each is home to 23 percent of the world's population -- 23 percent of the world's population -- and it can see the second last column on this table. Look at their water resources as a percentage of the world total. East Asia has 7.9 percent of the world's water and South Asia, 4.1 percent. And when you compare China and India, you get the same reflection. This looks at water from four different angles, and from each angle China comes out better, even though China in the north faces a very serious water crisis.

Another facet about Asia is also unique. Almost all the major river systems of Asia originate from the same region, the Tibetan Plateau.

One minute.

It wasn't geography but guns that established this kind of Chinese chokehold on transnational water resources. Asia's water map fundamentally changed after the 1949 Communist take over in China. Today, China is the source of river water supply to 13 countries in its neighborhood. There is no other country in the world that comes close to the hydro supremacy that China has established.

Cross-border dependency on water flows is high across Asia. Now, this map shows the cross-border flows in cubic kilometers per year in Southeast and South Asia. But you have the same situation across Asia. Only one country is happily placed -- China. Its dependency ratio on external inflows is one of the lowest in the world, less than 1 percent, even lower than Canada's. Canada, as you know, is the freshwater

world's king.

The fact that most Asian countries are dependent on cross border flows to a significant degree makes water cooperation central to ensuring Asian peace and stability. The question is how does one bring China onboard? Because there are watersharing treaties in South Asia, there's the Mekong Treaty in South Asia, and so with era arrangements are still in place in Central Asia. But China does not have a single watersharing treaty with any neighboring country. It is willing to share flow statistics. It's willing to sell hydrological data to downstream states. And it flaunts all these agreements it has signed on hydrological data sharing, which are commercial accords, not accords of cooperation. It does not have a single watersharing treaty.

Now, without bringing China onboard it's impossible to establish a rules-based water regime in Asia given the centrality of China. In fact, China has openly championed the principle of absolute territorial integrity. In 1999, the U.N. General Assembly adopted the first-ever attempt to fashion an international water law on shared water resources. The full name is the United Nations Convention on the Law for the Non-navigational Uses of International Water Courses. Only three countries voted against it. Two are hydro-hegemons in their respective regions. One is China; the other is Turkey. And they bribed a little African country called Burundi, which was then engulfed in civil war to vote with them. When that particular law was adopted by the U.N. General Assembly, the Chinese ambassador placed on record the reason why China had opposed it, openly citing the principle of absolute territorial integrity or absolute territorial sovereignty. This principle actually goes back to the Harmon Doctrine in the United States. Mr. Harmon was the U.S. attorney general, and in 1985 -- sorry, in 1895, he put forth this thesis that the United States owed no obligations whatsoever to Mexico. It could divert the waters of the Colorado River to the extent it wanted. And despite the

Harmon Doctrine, the United States went on to sign watershedding treaties, first with Canada, and then with Mexico. So the Harmon Doctrine stands discredited. But in today's context, China is the biggest proponent of the Harmon Doctrine. So bringing China onboard is critical to establishing water peace in Asia.

This is a chart which shows rivers flowing out of China, and this is not a full list of all the rivers. For example, the Red River, which flows to North Vietnam, is not listed, but these are some of the important rivers that flow out of China, showing China's unique riparian status and role.

But if I could just go back to one slide that I missed. This is from a U.N. index, a measure of per capita water availability for human, economic, and ecological users. Since 1980, this index looks at water available for development in all Asian countries. In this graph I've only chosen a few countries so as not to clutter this graph, but this particular -- this set of countries reflect the larger Asian pattern. Except for the Philippines and other tropical countries where the decline has been marginal, there have been sharp declines in most other Asian economies. The sharpest decline has been in India. And what this index shows is that there is an average decline of 1.6 percent in per capita water availability per year in Asia. And this has been going on unchecked. This decline is greater in Northern China, most of South Asia, parts of Southeast Asia, large parts of Central Asia, and parts of West Asia. And the big question that arises when you look at these stats is whether Asia will be able to address this water crisis in time before its economic growth story begins to stall.

What are the factors behind Asia's water crisis? One risk factor is Asia's dramatic economic rise. Water shortages were relatively unknown in Asia until the 1970s or even until the 1980s. It's only the last quarter of a century that water shortages have become apparent. So this is a new phenomenon; a phenomenon that has arisen

because of the economic boom in Asia. Of course, Asia's water availability in the first place was rather low by world standards but this economic boom has put tremendous pressure on scarce water resources.

But there are also other factors equally important, less known, that are responsible for exacerbating the water crisis. One is irrigation, which has proven to be both a blessing and a curse. A blessing because until the 1960s, Asia was a continent of serious food shortages. Then in less than one generation, Asia became a net food exporter. This dramatic economic success story was built on the back of an unparalleled irrigation expansion. Between 1960 and 2000, Asia more than doubled its total irrigated acreage. Now, it is the world's irrigation hub. Seventy-two percent of the world's total irrigated land is just in Asia.

Now, this success has come at a tremendous price. Eighty-two percent of all water used in Asia is channeled to agriculture -- 82 percent. Leaving only 18 percent for industry and municipal supply. Looking ahead, this kind of water usage in agriculture is simply not sustainable because the fastest demand for water in Asia is coming not from agriculture but from industry and from cities in keeping with the fact that Asia is now the seat of the world's fastest industrialization and urbanization. This trend demands that Asia make major savings in agriculture -- immediate water savings in water agriculture -- because without making those savings there won't be water available for industrial expansion and for municipal supply.

Now, this is a chart showing the world's leading rice exporters and importers. You will see that the Asian economies dominate the rice trade. Why have I chosen rice? Because rice of all the grains is the most water-intensive food product. To grow rice you have to flood the fields for three to four months continuously. Rice acquires what's called bonded culture. That is, you turn the fields into a pond on a

continuing basis and that's how the best varieties of rice are grown.

Now, you can see from this list water stressed countries are the world's leading exporters of rice. Take the case of Pakistan. Pakistan is the world's third biggest rice exporter and the world's fourth biggest cotton producer, another very water-intensive agricultural product. Now, is this a pragmatic use of scarce water resources? These countries like Thailand, Vietnam, Pakistan should be importing water-intensive products from elsewhere and selling products that are low in virtual water content, rather than actually exporting water in virtual form to other countries.

Ever the factor contributing to Asia's water crisis is consumption growth. Asia's population growth rate is on the decline, but its consumption growth rate is soaring. The average Asian is consuming more water, energy, food, and even metals. And no wonder natural resources are under strain, not only in Asia but Asian economies are scouring for natural resources elsewhere in the world. The changing consumption patterns are most visible from the changing diets. Diets in Asia have changed in one generation. From the traditional diet rich in rice and noodles, it's become a meatier diet. Changing diets has meant a greater intake of meat, which is notoriously water intensive to produce.

I mentioned to you how water intensive rice cultivation was. In this chart, beef production on average is 10 times more water intensive than growing rice, wheat, or corn -- 10 times more water intensive. Why is meat production so water intensive? It's because it's a more indirect way of generating food for human consumption. When we feed animals plant-based calories, animals only can burn between 5 to 15 percent of those calories into meat. So you require a lot more water to produce the same amount of animal proteins and calories in comparison to equivalent plant-based calories and proteins.

To give you one example of how diets have changed in China, there was hardly any beef industry in 1980. Today, it's the world's second largest beef industry. In the last 30 years in China, meat consumption has soared four times, and between now and 2030, according to FAO's projection, meat consumption in China will further double. China is not an exception; it's part of the general trend that we see in Asia, with the sole exception probably of India. Why? Because a large segment of the Indian population is still vegetarian. This is the only silver lining in India's otherwise dismal water situation.

A final factor behind Asia's water crisis is the long-term environmental degradation resulting from large-scale impoundment of water resources by building dams, barrages, reservoirs, and other structures. Compounding the situation is human-induced environmental change. Human-induced environmental change is a stepping stone to climate change. We keep blaming climate change for everything. Climate change only takes concrete form when we human beings denude the nature of critical ecosystems.

To give you one example of how we contribute to climate change in Asia and beyond, these are two pictures taken by satellite 42 years apart. The top picture was taken in 1950, and the different shades of blue that you see in the top picture are different types of forests in the Tibetan Himalayan watershed. And these forests were located in the same region where the great river systems of Asia originate. You see the bottom picture. By 1992-1993, most of those forests have disappeared. Now, this has serious hydrological implications because forests are essential to stabilized river flows and to regulate runoff regime. So the way deforestation has happened in the Tibetan Himalayan watershed, carries long-term environmental implications.

Another example, the (inaudible) introduction of cotton monoculture in Central Asia and the environmental catastrophe in the Aral Sea. The Aral Sea has shrunk three-

quarters. Large-scale -- I should say large dams in Asia have caused river fragmentation, habitat loss, destruction of species and other environmental and public health problems; yet as this particular slide shows, the dam building spree continues.

This is a map released by Hydro China Corporation. Hydro China Corporation is China's leading dam builder. This was released in June 2010, and it shows new dams approved for construction and dams under construction in 2010. Now, this map is only illustrative of the point that I'm trying to make, which is that dam building on a major scale is still big business. Now, if you look at China in particular because China is always an interesting example to cite because especially in the dam building area there's no parallel to what China has achieved. There are about 50,000 large dams in the world, slightly more than half are in just one country -- in China. I'm talking of large dams. A large dam is defined as having a structure of at least 15 meters or a reservoir capacity of at least 3 million cubic meters. So of those 50,000 large dams, between 25,000 to 26,000 are in just one country. So this means that on average China has built one large dam per day since the communist takeover. One dam per day, one large dam per day continuously since 1949. And if you include dams of all sizes and functions, the total for China exceeds 90,000 -- 90,000 dams in one country.

But look at the social costs of the dam building. Premier Wen Jiabao told the National Assembly in 2007 that from 1947 till 2007 -- sorry, from 1949 to 2007, China had forcibly uprooted 22.9 million people to make way for dams and other water projects -- 22.9 million people, which is larger than the population of Australia. Since then, officially, another 400,000 people have been evicted. So in all 22.3 million people officially have been uprooted to make way for dam projects. And I was calculating how many people have been uprooted every day. It works out to 1,030 people evicted every day from 1949 till today.

No other country in the world can evict millions of people, but these are the social costs that China is paying. And only now in recent years there's a new environmental movement in China which is raising awareness on these issues. For the first time I find that Chinese state-run media is beginning to highlight these issues. *Chinese Daily*, *The People's Daily*, and other leading media publications are increasingly drawing attention to the costs of the dam frenzy that China is still engaged in.

This is part of the same trend that Jennifer referred to -- the South-North Water Diversion Project. The eastern route is almost complete. In fact, it's operational. Having built an eastern route, they realized after having started the transfer of water that once you take the water from an actual waterway through an artificial waterway, the water degrades very quickly. So after having built that eastern route, now they have built more than 400 treatment plants along the route to treat that water. The cost is so prohibitive that they will not even disclose what's the total cost of transfer from the Yangtze Basin to the Yellow Basin. Yet, this year and next year they will evict 350,000 people to make way for this central project, the central route whose largest segment will be complete by the end of next year. The western route is to be started only after the central route is complete. But these programs are running behind schedule as Jennifer mentioned.

One other point. Asia's river systems depend on the constant flux of glaciers and on mountain snows. Rain in Asia falls mostly in a short season, the monsoons; the rest of the year is relatively dry. Asia's great river systems are sustained by melting ice and snow, from early spring 'til late autumn. The accelerated thawing of ice and snow that we are witnessing now carries long-term implications for the densely populated regions that depend on these river systems. What we will see between now and 2050 or so in the next few decades is increased melt waters before the situation

changes very suddenly from plenty to paucity of resources.

Finally, there is this warning from U.S. intelligence in a report released nine months ago. This warning is especially relevant to the Asian context because water has emerged as a new arena in the Asian great game. Water will determine if Asia is headed towards greater cooperation or greater competition.

Now, my last point is what are the possible mitigation measures given this crisis? How do we reduce the security and economic risks arising from the water crisis? I think on the security side the options are obvious. The fact that we don't have international water regime, there's no international water law currently in force, makes basin level or regional level cooperation the only option. RBOs -- that is river-based organizations -- and other water institutions offer constructive dialogue and structured cooperation. Their institutional, legal, and consultative mechanisms act as a safety valve in a boiler by releasing pent up pressures generated by popular passions and whipped up apprehensions. It's so easy to whip up apprehensions on water because water, like religion and political ideology has the power to unleash grassroots passions and therefore you will notice that despite the crisis in Asia much of the public discourse in Asia on water occurs along nationalistic lines. There is an open discourse about larger ecological issues, about basin-wide imperatives, and even the data on water resources is closely guarded in Asia. There is very little data the governments release in Asia on their water resources.

So on the security side, basin level institutions are the only way out. On the economic side, there are three sets of options that we have. There is no single pathway or a silver bullet to resolve all of Asia's water problems, but if these various options are pursued in conjunction, they together can help to mitigate the economic risks and lower the conflict potential. These three areas are one, securing higher water

efficiency and productivity gains. And here the centrality of making water savings in agriculture stands out because without cutting water use in agriculture -- yes, I'm just finishing in one minute -- without cutting water use in agriculture, Asia's water crisis will not be addressed.

The second area is clean water technologies. Here, just the way in the energy sector, we have managed to reap new benefits from the shale oil and shale gas boom from tar sands and from deep sea exploration in the South Atlantic. Similarly, in the freshwater sector, using clean water technologies to open up unconventional sources of supply is going to be critical. And that includes desalination, waste water reclamation, and cleaning up contaminated surface water.

And the third area is upgrading and enhancing the water infrastructure. And here three subcategories are important -- storage and supply, distribution networks, and pipelines. Storage and supply are going to be critical because in Asia, given the fact as I mentioned that much of the rain falls in the three to four month monsoon season, trapping the rain and the melt waters in the wet season for release in the dry season will have to become an important component of crisis mitigation because the earth's water renewable capacity is finite, has remained the same since the first woman or man appeared on Planet Earth. And that capacity theoretically is 43,000 billion cubic meters per year. But two and a half times that amount falls in precipitation. So even if we capture 5 percent of the rainfall, it'll translate into 12.8 percent increase in net water resources of the world. Distribution efficiency and pipelines should take water within countries from areas where water is surplus to areas seared by scarcity will have to be part and parcel of crisis mitigation.

So let me stop here. Thank you.

(Applause)

MS. MADAN: Thank you. Now that we're all mic'd up, I'm going to throw out a couple of questions to start with for Jennifer and Brahma, and we'll do a second round of questions and then we'll throw it out for audience questions.

First, you know, Brahma very much laid out China's essential character in this kind of Asian picture. And I had a couple of questions about the neighborhood.

So Jennifer, for you in your work and your conversations, how much is there a realization of the impact this is having in China of the impact this is having on China's neighbors and potentially on China's relations with each of these countries that are lower riparian countries?

And to Brahma, if you could elaborate a little bit on China's kind of river (inaudible) relations with one particular country, India. Where do you think the potential for conflict is? And how do you actually think that could be mitigated so we don't get to that point?

Jennifer.

MS. TURNER: Well, I think, I mean, he's probably the bigger expert on the dam side but I think Brahma had it right; that in China the government position is we have the water. And China's really -- but they are struggling because the water levels are actually going down. And there is more talk, as Brahma mentioned, in the news media starting to question, I mean, even within China all this rapid dam building.

One thing that I didn't mention because I skipped over dams a bit was that in southern China the dams that are going up now, even the most recent ones, their water levels have gone down. But so what they've been doing is they now build every dam with a coal-fired power plant. And so we're seeing coal use actually going up in southern China, which also has a big water footprint. And I think that within China they're even starting to question, you know, at the same time, I mean, they have 60 dams

planned for the next five years. But I think that in general, I mean, they're pretty much focused on their own dam building but they're also investing in Southeast Asia. And I think that what you're seeing in China in terms of this rapid dam building, it's just replicated all through let's say even the Mekong River Basin. I mean, all the other countries are doing the same thing. Thailand is investing in dams in the lower Mekong to supply some of their energy, rather than conserve, Thailand is focused on just dams. I mean, the model goes all the way down. And so I think that, you know, when China looks at that they're like everyone is doing the same thing, right?

MR. CHELLANEY: Well, I'd like to just add one qualifier there.

MS. TURNER: Please do.

MR. CHELLANEY: Which is that the dams that have been built downstream are actually so small. For example, if you look at Southeast Asia, just one dam that China has built, the latest one, Nuozhadu just recently commissioned. Its total install capacity is 5,800 megawatts. That's higher than the entire capacity of Southeast Asia to generate hydropower. Just one dam's capacity. And the dam before Nuozhadu built by China, Xiaowan, its capacity is 4,200 megawatts. It's taller than Paris's Eiffel Tower. The dams that are being downstream are small. They are modest dams. It's not the number of dams. The fact that China has graduated to building mega dams and that the focus of Chinese dam building has shifted from the dam saturated internal rivers, into international rivers and that these dam projects are coming up quietly, there is no attempt even to discuss this issue with any neighboring country. In fact, the attempt is to keep the project under wraps until it can no longer be hidden.

And I think this is the kind of unilateralist approach which is creating these kinds of tensions and misgivings, which I think policymakers in Beijing need to understand. They need to understand that the costs of this kind of unilateral hydro

engineering strategy, the cost of that in the long run for China are going to be high.

Your question was specifically about?

MS. MADAN: Sino-Indian.

MR. CHELLANEY: Sino-Indian. Of all the countries that are likely to be affected by China's dam building spree, India is most vulnerable. Why? Of course, the country is located furthest downstream. Vietnam and Bangladesh will suffer the most because they are downstream furthest on international rivers; Bangladesh on the Brahmaputra, which is the source of supply for Bangladesh of more than 50 percent of the freshwater, and Vietnam, because it's downstream on two rivers. The Mekong is the main river of South China and the Red River is the main river of North Vietnam. Mekong is the main river of South Vietnam and the Red River is the main river of North Vietnam. And both these rivers originate in Chinese-controlled Tibet.

So Chinese dam building on international rivers carries the greatest implications for countries located furthest downstream. But in terms of a country dependent on cross borders that flows from Chinese territory, India ranks number one. Of all the water that is flowing from Chinese territory to other countries -- I would say there are 13 countries -- India alone gets more than 40 percent of all the water flowing from Chinese hill territory to other countries. Eleven different rivers flow into India from Tibet and therefore, the long-term implications for India, the fact that more than one-third of India's water -- entire water comes from Tibet. The long-term implications for India are quite serious.

Now, what has India done? India has tried to raise this issue diplomatically with little success, but in recent years it has been raised publicly by Indian leaders. Water has become the new divide between China and India. Where it was land, now it's water. Since 2006, when Hu Jintao came to India, to New Delhi, the Indians put

forth their concerns about water. The Chinese have been willing to only discuss this at a bureaucratic level, so there's a mechanism on hydrological data which the two countries have established, but beyond that, China's government has been unwilling to do anything.

And the question is what can a downstream country do? India has watershedding treaties with both countries located downstream to it -- with Pakistan, which is the world's most generous watershedding treaty. There's no other treaty in the world in terms of water allocations which come anywhere close to it. The annual out flows from India to Pakistan are 167.2 billion cubic meters per year, which is 90 times greater than Mexico's share under the 1944 water treaty with the United States.

So the Indus treaty really is a colossus and India also has a watershedding treaty with Bangladesh, which also established a new principle in international water law. The downstream country gets a fixed guaranteed share in the driest part of the year which has helped to assuage Bangladeshi concerns. The question is what can India do to persuade China to emulate its example? The answer -- very little. Short of waging war, India's options are nonexistent because diplomatically the Chinese are not willing to listen. Public pressure -- they're not willing to yield to public pressure of any kind. Internationally, they do everything possible to deflect attention from these issues. If they're invited to join the Mekong River Commission, they say we want to do it bilaterally. But with India they don't want do it bilaterally either or with Kazakhstan, with Russia, for example. Russia has been saying let's do it bilaterally. They will not have a bilateral arrangement with Kazakhstan, with Russia, with India. So the question is what can be done?

MS. TURNER: Can I just interject?

MS. MADAN: Sure. Absolutely.

MS. TURNER: But also let's think about when China's building all these dams where is the energy going; right? We've got a great -- next week we have an info graphic. We could get data on how all these western provinces are, you know, the coal in the north, the hydro in the south; they're moving that power to the coastline, to the factories, to the cities -- the factories that make our stuff. Keep the prices low. And, you know, so there is -- you can actually track, you know, this global supply chain impact here. I mean, the Chinese government's priority is to keep the energy on. You can't have brown outs; you can't have blackouts. They need to urbanize -- the government wants to urbanize another -- what is it, 300 million people in the next 10-15 years. And again, cities need energy and the people in the cities need energy.

So you have to keep in mind that the focus of China and, you know, I totally agree with you. You know, they're not talking to you guys in India because they're focused inward. We've got to keep the economy booming because that's the foundation of political legitimacy in China. But again, hydro is part of -- you know, I'm looking at the water security angle from the water energy nexus. Water serves energy.

MS. MADAN: On that, I mean, on that, on the water energy nexus and from a kind of U.S. policy perspective partly related to climate change issues, one of the things that the U.S. has been doing is encouraging India to go towards perhaps people don't like to call it clean coal, but cleaner coal technologies such as carbon capture and sequestration, as well as shale gas, which they're helping India survey.

MS. TURNER: And China. Same thing.

MS. MADAN: Both those require a lot of water.

MS. TURNER: A lot of water.

MS. MADAN: How do you think the U.S. should balance the climate change imperatives and kind of this water security?

And a follow-up for Brahma, how much of this is partly, I mean, you talk about water nationalism in your book, but also these treaties. How much of this is also a problem of perception when it comes to actually negotiating agreements both on the bilateral and regional levels? You mentioned India's treaties with Pakistan and Bangladesh. If the same question is asked in Pakistan and Bangladesh, they don't -- there are many stakeholders there who do not think that those are very fair treaties. There have been calls to renegotiate India's water treaty for example in Pakistan. So how do you actually go about, you know, bridging this gap between perceptions of what is equitable for various countries on both sides?

Jennifer.

MS. TURNER: I think what you mention about India. I mean, the U.S. engagement with India on cleaner coal and shale. Actually, you know, they kind of started it more -- they've been doing it more extensively in China. And I think the thought is -- particularly with China is that because their energy sector is growing so fast that China can be the laboratory; that if any country in the world can come up with a more efficient way to do carbon caption sequestration, it's go t to be China. Same thing for desal. A lot of coastal cities in China who don't want the South-North Water Transfer water because it's too expensive as Brahma mentioned, they're starting to say, well, actually, desal is cheaper because I've got the coal. Right? My coal is subsidized. I can use coal to supply these desal plants to get me my water. And so it's -- my main point that I didn't probably make as clear in my presentation is that the true cost of coal in China has been ignoring the water piece and that needs to change. And so in terms of, you know, I'm kind of hoping to spark more interest, you know, with the U.S. and others working with China to look at water. Have you guys picked that up today in my talk? I want you to think about water. That energy is not just energy. And the water piece is big.

And there's a lot, you know, people in China have been very receptive. And so China becoming more efficient in their energy sector. But again, that has ripple effects throughout the economy, and I did love your ending points about, you know, what needs to be done throughout Asia and water efficiency is key. But the energy sector has got to be a big part of that efficiency.

MR. CHELLANEY: I think the water energy nexus is such that it's already imposing important costs on Asia. For example, many of the world's nuclear power plants have been built, almost all in Asia except for two which have been built in Europe. All others are being built in Asia. And you'll find that all these nuclear power plants now have been pushed to the coastlines. You can't build a water guzzling nuclear power plant inland anymore in Asia because of all the sources of energy, the most water intensive is a nuclear power plant.

Second, about the energy water and excess is the fact that even coal fires power plants, new ones, their location is very much being constrained by issues of local water stress. Now, you have to build plants far away, not where the demand is, and then there's a loss in transmission by bringing power all the way to water scarce areas. This is the same thing that the United States is facing in the American southwest. That's where the demand is growing the most but that's where the water scarcity is also the most apparent. So how do you basically balance energy demand with the fact that water resources are not adequate to generate energy?

And the flipside of that is that water provision is becoming more and more energy intensive because of water stress. Now, water has to be extracted from greater depths and transported across longer distances which requires more energy intensity. And these costs have not been passed on in most countries to the end-users. So the governments and utilities are getting double bidding because on one hand the

costs of water supply are rising everywhere in the world, and those costs have not been passed on to the end-users. And nowhere in the world do we have a market pricing mechanism for water. There are some water markets now in the American west, in Australia, and Chile where water rights can be treated like property rights.

But I'm talking about a market price for water. Even American consumers do not pay the market price for water. Like in Washington, D.C., the water supply is subsidized indirectly. Right? Now, in no OECD country is there a market price for water. Now, when you tell the Asian governments that you need to move in a different direction, if you're following a different part in the U.S. or in Europe, how do you get the Asian governments to embrace water reforms of a fundamental type?

But coming to the question that you asked -- this was a digression --

MS. TURNER: It's a fun digression.

MR. CHELLANEY: -- on treaty making, whatever kind of water arrangement you have between two countries or more will never satisfy one side. Or in fact, will not satisfy both sides if the two parties -- if they are both in two parties, it will not satisfy any site. This is water. As I said, water nationalism is at the core of all the problems that we are facing. Why is the water sector everywhere mismanaged? Because there is no public discourse objectively. In most countries, water policy is the domain of hydrologists and engineers. Hydrologists and engineers are the wrong people to be in charge of policymaking on water. They may be experts on water but they have no idea because they are supply side people. They do not understand integrated holistic management of natural resources. We need a different approach for natural resources.

And coming back to the treating making issues, specifically to the India-Pakistan or India-Bangladesh context that you mentioned, there may be unhappiness on both sides. The fact still remains that there is no example in modern world history of an

upper riparian leaving 80 percent of the share of a river system for a downstream country. And there is no example in modern world history of the upstream country leaving 167.2 billion cubic meters of water for the downstream country. The other agreements that we have in the world are all in millions. The Israeli-Jordanian agreement, in millions. Million cubic meters. Not billions.

Now, the good thing about the India-Pakistan agreement is there's a treaty in place. If there are disputes, there is a way to resolve them. Either you're going to appoint a neutral international expert as happened in one dispute called the Baglihar hydropower plant in India, and more recently, the Pakistanis have taken another dispute to international arbitration. So when you have a treaty arrangement, this is a framework to resolve disputes. That's why treaties are so important. If you don't have a regime in place, if you don't have a water institution in place, then there is no way differences and disputes can be resolved.

Now, for example, for three years now international arbitration proceedings are continuing on this India-Pakistan dispute on a small little Indian hydro plant called Kishanganga. It's only 330 megawatts. By Chinese standards it's, you know, insignificant. They don't build such blocks, you know. But the Pakistanis have taken umbrage and dragged India into international arbitration proceedings. The only happy people are the arbiters because every year millions of dollars are being paid to these arbiters. Millions of dollars by each country. And for three years they haven't resolved this dispute. There's still the outcome of the award. They will prolong this case to the longest possible. And because it's international arbitration proceedings it works on the simple principle of lowest common denominator, which means no side will be happy. Only the arbiters will be happy.

But at least the good news is that India and Pakistan will not come to war

on water because there is a mechanism in place, and that's why we need regimes of this kind. We need water treaties between countries, even if they are imperfect, even if they have -- even if they need to be refined, further. The fact is that on this that it's rules-based cooperation in place. We will not avert conflict

MS. TURNER: I wanted to ask Brahma, you know, in India -- in China though, you know, like river basin management, it's all very top down. Like you said, those hydrologists are in charge. And even the Yellow River Basin, which has this agreement to share water, it's not negotiating with the provinces; it's telling the provinces. And I think that's also another obstacle to when you're talking about, well, why isn't China doing this kind of agreement that their own river basins -- I mean, they have river basin commissions but there are no commissioners. And so there is that challenge, too, that institutionally they don't -- they're talking it now. I mean, the Ministry of Water Resources is saying we need to have ecological flows and things but, I mean, not to be pessimistic but that is another obstacle that you just don't even have that kind of concept being used in China even though there are NGOs pushing it.

MS. MADAN: We will open the floor to questions. If you could please identify yourself and your affiliation. Charley.

MR. EBINGER: Charles Ebinger from Brookings.

Given the obvious benefits --

MS. MADAN: Charley, if you could just wait for the mic.

MR. EBINGER: Given the obvious benefits in the electricity trade, irrigation, downstream irrigation, flood control and potable water supplies, why do you believe it's been so impossible for the governments of India and the government of Nepal to develop Nepal's vast hydroelectric and water resources of a benefit to both nations?

MR. CHELLANEY: Good question.

Look at the paradox. One of Asia's highest per capita freshwater availability is in Nepal. Yet this country imports power from India. And Kathmandu the capital is really under a water crisis. Can there be a greater, you know, a better case of -- alarming case of mismanagement of water resources in our water policy? No. The problem with Nepal is -- and I say it with all due respect because I love the country -- is that ever since democracy was thought to be introduced in 1990, democratic experiment has not taken off. And that country has been teetering on the brink of one crisis after another. It is -- it looks as if it's a failing state. This almost political chaos there, how you rectify the politics is the key to a better energy and water future for Nepal because Nepal can be like Laos wants to be. Laos wants to be the battery of Southeast Asia. Nepal can even more. Nepal can actually be a battery. It can be a freshwater supplier. It can be actually -- it can actually generate hydro dollars and become a booming economy if it were to put its house in order. I've been hoping every year that the politics, they would improve. But last year was terrible and this year doesn't show any sign of improvement in Nepalese politics.

But often I find that in many countries -- Nepal is just one example -- that the key to better water management is better politics. And without better politics, we will not have better management of natural resources. In fact, it's a vicious circle. When you have bad politics and bad governance, it leads to depletion and degradation of natural resources. That in turn compounds the challenges on the waterfront as well as on other natural resources. So it becomes a vicious circle that traps a nation.

MS. MADAN: Next question. The gentleman over there.

SPEAKER: (Inaudible) Jayendra Kumar. I'm in small business.

To Mr. Chellaney, what would be the impact of improving crop yields in India as far as water conservation?

MR. CHELLANEY: Sorry. Say that again.

SPEAKER: Crop yields in India. They're the lowest in the world. So what would be the impact of improving crop yields on water conservation?

MR. CHELLANEY: Well, crop yield growth is critical to increasing food production. I don't think the Indian crop yields are the lowest in the world. They are low. By Chinese standards I would say I think the Indian crop yields are much higher than Pakistan's but lower than China's. But I think overall looking at the Asian picture, what's happening after the big economic success story that Asia achieved, crop yield growth has flattened or slowed across Asia. Now, this is not a good sign for Asia's future trajectory because Asia needs to grow more food with less water, less land, and less energy. Why less land and less energy? Because even farmland is shrinking because of the increase in the size of cities and the advent of new cities and new industries. And less energy because nitrogen-based fertilizers have been a principal culprit in soil degradation and water pollution. So Asia's big challenge is to grow more food with less water, less land, and less energy.

Now, this requires basically better farm varieties, better techniques, better irrigation methods. And I think one of the reasons why crop yields are not that high in India is because of what Jennifer also mentioned -- the fact that in India farmers have no penalty to pay for recklessly extracting groundwater. And fertilizers for them are subsidized by the government. They are, you know, far below what -- in terms of the market price, you know, they are getting one-fifth or one-fourth of what the market price ought to be. So they are overutilizing fertilizers and overextracting groundwater resources, and these distortive subsidies that we have in India. Also in China, for example, and several other parts of Asia -- it's not just India -- that we have these distortive example laxities to power pump kind of subsidies which allows overextraction of

underground water reserves. These subsidies have to be more carefully targeted to the right segment of the farm community, not to rich farmers. You know, the allocation of subsidized resources to powerful lobbies, including rich farmers, is creating depletion of natural resources and therefore, the food policy -- food, energy, and water have to be linked holistically.

In India, water is handled by guess how many different departments and ministries? Not one but 12 different ministries handle water. Twelve different ministries handle water. Imagine how many different ministries handle food and energy. A friend of mine came from Germany. He was trying to promote nonconventional energy in India and he said he had to hop from one ministry to the other. He had to go to three different ministries to sell his product. Not that he managed to sell his product but he hopped from one ministry to the other because nonconventional energy in India is handled by three different ministries; water by 12; and food by, fortunately, by one.

But these different ministries and departments have to look at the water, energy, food nexus in a holistic manner. Only then can you deal with these challenges because policies that you adopt in one sector impinge on the other two sectors and therefore, you cannot pursue policies that are compartmentalized. In India's case, and also in the case of most other Asian economies I find that policies are very tightly compartmentalized, and as a result there is no integrated management of resources.

MS. MADAN: Next question.

MS. TURNER: You can say the same -- your story, it's nine ministries in the water in China. The nine headed dragons. So a similar kind of difficulty in managing.

MR. HASKELL: Hugh Haskell from the Institute of Energy and Environmental Research.

This conversation has gone on with almost no mention of global warming

and climate change. But as things are going now, that's going to eventually impinge seriously on surface water. At the same time we're drawing water from the fossil aquifers that aren't going to be replenished for millions of years. What can we do to get the energy sources back away from the water-using methods?

MS. MADAN: Jennifer, do you want to tackle this?

MS. TURNER: Well, yeah. I mean, in some ways I didn't intentionally not mention -- I mean, I mentioned a little bit but I think that looking at the water energy nexus, I am really talking about climate change in a lot of this. I mean, the fact that coal is the story in China and coal is a major climate pushing source of energy. But you're saying like what can we do? I mean, part of -- for me looking at China and eventually I don't want to say this, you know, just start with India, but looking at China is that coal, while it's a big CO2 emitter, again, the water footprint is large. And taking -- when you bring the cost -- when China and other countries start seeing the true cost of coal, I mean, yes, there's the health effects. I mean, Beijing, I mean, how many, you know, there are some really scary statistics coming out in China that even the Chinese -- the universities are reporting on how many people are dying from coal -- you know, the PM2.5. But when China can start integrating the cost -- the water footprint into coal, it also starts making coal even more expensive and it helps make it, you know, the measures that they're doing. You know, China has been pushing massive amounts of energy efficiency. In the 11th five-year plan they dropped their energy intensity by 20 percent, and they plan to do it again. I mean, China has made great strides to reduce its CO2 emissions over the past particularly five years and they're still going down that path. The challenges are for China, just because their electricity needs just keep growing because they remain the world's factor.

And so one strategy that some Chinese environmental NGOs are doing

is actually starting to make this part of the global supply chain; that in some way costs have to go up. I mean, if China is our factory, and as China brings up the cost of water and the cost of coal, your adventure to Wal-Mart is going to look a little different; right? So really it is kind of -- some of the stories that more environmentalists are starting to tell is that while it is China's problem and India's problem, but there is a global linkage to it. So there is the supply change angle which it's messy. But it also makes us, you know, we have to look in the mirror a bit, too.

MR. CHELLANEY: If I may just add --

MS. MADAN: Sure, absolutely.

MS. TURNER: Please do.

MS. MADAN: Brahma, to add to that, I mean, just also if you could talk about at a broader scale, but given the projections for the Indian energy picture show that under any circumstance fossil-fuels will continue to play a huge role, how can the Indian government attack both the kind of energy question and moving away from some of these to the extent possible but also on a kind of more 30,000 feet point of view in terms of climate change, what can India actually do? Or should it do?

MR. CHELLANEY: There are two aspects about climate change that we need to be cognizant of. One, that the Himalayan and Tibetan glaciers are thawing at an accelerated rate, there's no doubt about it. But the more recent studies have shown that they are thawing at the same rate as the glaciers in the Rockies, the glaciers in the Andean range, or the glaciers elsewhere. There was only the concern that the Himalayan glaciers were thawing at the fastest rate in the world. No, the most recent studies show that is not true. Yet, the implications are still ominous for Asia because half the world's population depends on the river waters that flow from the Himalayan and Tibetan glaciers.

The silver lining, if I can call it a silver lining on climate change, is that the increase in surface temperature will bring about more precipitation. Also, it is assuring that in a global warming driven paradigm, Asia will get more rain. Especially in the tropics and subtropics, there will be much heavier rain fall. Each degree in increase in temperature will substantially increase the capacity of the air to hold moisture. And this global trend of increased precipitation occurred right through the 20th century. So we're not talking about a possibility; we're talking of a pattern that we have seen for more than 100 years now of increased rain and snow in the world. But this would be more pronounced in the monsoon lands of the world, which is Asia. That there will be increased precipitation.

So the big question, and it goes to the heart of the question that you put, how do we actually deal with climate change in terms of water resources? Because climate change itself is a very broad subject. And I think this is one of the points that I had made in my presentation which was storage and supply. Because there will be more rain coming in the monsoons. We will need more storage capacity. Asia has, other than Africa, the lowest per capita storage capacity for water. So increasing water storage in the wet season for release in the dry season will have to be part and parcel of crisis mitigation of dealing with climate change. But then the downside is this will mean building more dams. Right?

MS. TURNER: Which you don't like.

MR. CHELLANEY: Which in a country like India or Japan or Nepal; in democracy it is impossible not to build a large dam. There's no large dam built in India today because, you know, like the dam projects in India, which the government has tried to launch, one after another they've run into grassroots protests. In 2010, they canceled three dam projects. One they had built one-fourth of it. They spent $240 million on it.

They abandoned it on the River Baghmati.

So given the fact that in democracies it is not possible to build large dam projects, and that these kinds of structures are only possible in a system like China, what do other countries do? And even in China the costs -- environmental and social -- are so high. So how do we balance the fact that on one hand this dam building spree has to come to an end; on the other hand I am, myself, suggesting that dam building has to be part and parcel of this crisis mitigation.

MS. TURNER: But do the dams always have to be so large? Isn't that the major challenge is the opposition to the large dams in India?

MR. CHELLANEY: Exactly. Well, you can build small dams but if you're an investor it's like these hydro projects -- the two types of hydropower plants. One I call runoff river projects, which are small hydro projects. There's no storage. No reservoir. And then there are these big projects with reservoirs. If you are an investor -- if I was an investor I wouldn't put my money in the runoff river hydropower plant because the output is unpredictable. In the lean season, the power output declines because of the decline in river flows. So if I was an investor I would put my money in large storage type hydropower plants. Those are the plants that cause environmental damage; they impose social costs.

So none of the measures -- none of the options that we have are attractive by themselves. For example, clean water technologies, the economics is not favorable as yet, and yet the fact is that we don't have too many options. So we will have to use whatever we have in a way without causing more environmental havoc to future generations.

MS. MADAN: I saw a couple of other questions. We just have time -- the gentleman at the back and --

MS. TURNER: Yeah, we should be nice to the back of the room.

MS. MADAN: Yes. Just so that we're -- if we could take those questions together.

MR. VANTOAI: Thank you. My name is Norman Vantoai from the U.S. International Trade Commission.

I would like to ask Ms. Turner about a question regarding water use in other industries, especially applying to China that is still in the process of heavy industrialization. For example, let me take the steel industry, for example. China now produces -- I remember it's about 500 million metric tons per year. To put it in perspective, the United States produces around 100 million metric tons per year. So, and in the steel industry the use of water is also rather expensive for cooling, for heat treatment, for cleaning, and also in other industries, for example, the petrochemical industries. There is extensive use of water there. So could you please explain to us a little bit more about the effect of water use in China during the process of increasing industrial productions in the next few years? Thank you.

MS. MADAN: Can we take the other?

Sorry, could we take the other question as well?

MR. DILLS: Benjamin Dills from the Elliot School.

We've heard about grassroots movements in India. Oh, I'm sorry. Benjamin Dills from the Elliott School.

You've told us about grassroots movements in India impacting hydro projects. I was curious about how such movements in China were influencing the development of hydro projects.

MS. TURNER: Okay. Let me do that last one first.

Actually what's fascinating is that in 2004-2005, there was -- a Chinese

environmental NGO stood up against some of these dams that were going to be built on the Salween you know, which addressed a big concern that you had, right, about the dam building. And the short story of it is that it did lead the Chinese government to -- for a few years to put on hold -- to slow down a lot of the major dam building because, you know, Chinese NGOs have increasingly been starting to focus on the dam issue but also communities themselves. You know, I mean, there are protests against even these -- what they call small we still call big dams. But then that has been pretty much tossed aside as a way for China to meet its greenhouse gas reduction goals. You know, to the international community they stated how much they were going to reduce -- 40-45 percent of their CO2 based on whatever -- 2005 rates. That in the 12 five-year plan for renewable energy, you know, it's green energy. I'm sorry; you must cringe every time they say this. Dams are considered green energy and so they plan on building another 60 medium to large dams. There were some of those little red dots on your map that you had.

So hydro is seen as clean and green. But it was really fascinating to me to see this massive slowdown after this kind of national protest. And notably no one got arrested. But then there are, you know, some international organizations highlighting China's dam building not just in China but overseas. International Rivers Network, China's Great Wall, you know, Chinese hydro dam builders are going abroad to build these as well.

But no, you should come talk to me. We've done a lot of meetings over the years about the protests. But now a lot of NGOs are focused more on water quality issues, going more local because, you know, that's also a major challenge in the country as well.

Just real briefly, on water use in other industries, again, I feel like a

Chinese government official. The 12th five-year plan, it excited me because for the first time it's a little bit more aggressive on water. Targets for saying that industries must recycle 30 percent of their water. But notably, when we went to China and we're interviewing folks, you know, industries in northern China, we actually visited -- it's like the third largest steel plant in the world. It's in Gansu province. Who knew? But actually, that plant is recycling 90 percent of its water. I mean, northern China -- that's what I find really exciting is that while overall Chinese industry is very wasteful of water, in northern China there just isn't the water. And so they have started to become much more efficient. Even that gigantic coal-to-liquids plant that I showed you that picture of -- it was riveting, I know -- they actually recycle 90 percent of their water. And so you have efficiencies happening in Chinese industry simply by necessity but at the same time, when you go to southern China, much different story because there's a lot of water down there. Textile industry. Look around this room. Look at your clothes. The dyers, the manufacturers that put these clothes together? some of the most water-wasting and water-polluting in the world. That cost is not integrated. Our friends at Natural Resources Defense Counsel are working with those NGOs -- working with those companies in southern China to create low cost-no cost ways for them to really, you know, lower their water footprint.

And actually, the Chinese NGO Institute for Public and Environmental Affairs, Ma Jun runs it, if you're interested in the industry-by-industry, he started with the IT. He's on textiles now. There are reports coming out that this NGO -- a fascinating NGO in China is really looking at the water footprint, particularly of the pollution but you know, I know you're saying water use but really, the water footprint is broader with the pollution. So there are things out there.

And I couldn't see where you were, but you can come find me and I can

direct you to more studies on that because we're conscious of the time.

MS. MADAN: Yes, we are. Unfortunately, we do have to wrap up. It's a testament to the importance of this issue.

MS. TURNER: And I'm really excited to see all these people coming for water. This is good. This is good.

MS. MADAN: As Brahma said, "There's no substitute for it and we can't live without it."

So if you are also interested, the National Intelligence Council's Global Trends Report that was just released yesterday discusses water as an important security issue going forward; not just in Asia but globally as well.

Thank you all for coming, for braving the slush and what's left of the snow. I know Matt will join me and the Asian Society will join me in thanking both Brahma and Jennifer for participating on this panel. We'd also like to thank Kaitlin and Purwa for helping us organize this event. Thank you so much.

(Applause)

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