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Water is a critical factor for so many of the things that we really care about. We use water for producing goods and services, and to grow the food that we need. We survive only with fresh water. We are learning more and more that the scarcity of water worldwide is causing growing conflict. It's causing growing concern, and it's causing growing challenges for the world community.

Perhaps the greatest failure of development in the 20th century was our failure to meet basic human needs for water for everyone. It's now the 21st century and more than a billion people don't have access to safe drinking water. 2.6 billion people - almost half the world's population - don't have access to adequate sanitation services. These huge numbers are an indication of our real failure at meeting fundamental, basic needs.

There are different kinds of water issues facing the poorer countries of the world and the richer countries of the world. The poorer countries of the world have very serious problems with access to clean water, with terrible incidences of water-related diseases, with conflicts over water. And yet here, in the richer parts of the world as well, we have many problems. We have conflicts over water among cities, farmers, and the environment. We're having contamination problems with our ground water and over-pumping our ground water. We fight over the price of water. Global climate change is going to affect water availability and water quality in every part of the world. Water problems are not isolated in the developing world.

The problems of water in the developing world are problems that could come back to haunt us here in the rich countries as well. The failure to provide basic services and basic clean drinking water and sanitation leads to water-related diseases. The estimate is that there are 250 million cases of water-related diseases a year. Three to five million people die a year, 20 or 30,000 perhaps a day from water-related diseases that we know how to prevent, that are easy to prevent and to cure, but that we failed to prevent. This leads to lost educational opportunities, lost business opportunities, and ultimately, I believe, political instability in parts of the world. All of these things could come back to haunt us here in the United States as well.

The ultimate problem is not that we don't have enough water. We live, after all, on a water planet. The problem is that the availability of water varies enormously from place to place. The use of water varies enormously from place to place. The quality of water is very complex and varies from place to place. The problems that we have with water come from failures of our institutions, failures in many ways of our imagination and failures of will to really solve what are truly solvable problems. We have failed to meet basic human needs for water not because we don't know how, not because we don't have the technology, but because we don't have the will or the institutions to solve those problems.

Part of the reason why, in the 20th century, we failed to meet basic human needs for water for everyone was that we spent money in the wrong places and on the wrong things. We thought that we could solve the world's water problems by simply building more big dams and huge aqueducts to move water from one place to another, and giant centralized, waste water treatment plants and water service plants. Those are the kinds of things that we use to solve the water problems here in the United States and in Western Europe, in the richer countries. But it turns out that those are not the solutions that we need in much of the rest of the world. Those solutions, which worked for parts of the planet, will not work for everybody.

There are parts of the world where we still need new infrastructure, where we do need big dams, where we need centralized water treatment systems. But we've also learned that those systems alone are not going to solve all of the world's water problems. We need to invest in small scale technology, some of which is traditional technology like rainwater harvesting that's been used enormously in the past very successfully, but has not been part of the package of economic development that the richer countries have been offering. These kinds of community skill systems turn out to be much more effective at solving community-sized problems than the big infrastructure we've relied on in the past.

There's a real disconnect between the kinds of projects that big development organizations like the World Bank and the International Monetary Fund and Export Import Banks, big development agencies, know how to build and know how to fund and want countries to adopt, and the kinds of small scale community systems that may turn out to be cheaper and much more effective. It may turn out that you can meet a community's needs with a single, small dam that's locally designed and locally managed. In contrast a big, centralized dam a hundred miles away may provide some local benefits or some big irrigation systems for big commercial interests, but may never benefit any local people. That's one of the problems we discovered with the big projects of the 20th century and it's one of the reasons why we're desperately searching now for smarter, more appropriate scale technology.

Some of the new things that we're looking at are community-scale systems like smartly designed ground water wells that are designed and managed by the local community. In the old days, the richer countries would go and drill ground water wells. They'd put in a pump and they'd disappear and a year later the pump would break and there was no ability at the local community to fix it. When you have indigenous technology, when you have indigenous management, you have at least the groundwork for truly sustainable systems.

There are other new systems like smart water treatment plants that are on a much smaller scale than the big centralized plants we're familiar with in the big cities of the West. There are new technologies for monitoring water quality. We had some very ugly experiences in Bangladesh, for example, providing water supply without monitoring properly the water quality. And that led to an enormous problem, it turned out to be arsenic poisoning, a problem that's still unresolved in Bangladesh. But we're getting better at learning how to monitor water quality and how to protect water quality.

There's another aspect to this challenge that really has to do with rethinking the way we use water. It turns out we don't want to use water except for things like drinking and basic cooking and growing food. What we want is goods and services. We want to grow food. We want to produce widgets, computers, automobiles, clothing. Some of those things take water but if we can do the things we want to do with less water, we'll be better off. This is true in the richer countries where we waste a great deal of the water we use, but it's also true in developing countries. A good example is Mexico City. Recently in Mexico City they invested in 350,000 efficient toilets. They replaced leaky, high-flow toilets with efficient low-flow toilets and they saved enough water to meet the entire water needs of 250,000 more people living in Mexico City. It's a way to take the water that we're already using and spending money to capture and clean and deliver and do more with it.

I think the best estimate now is that nearly 80% of all of the water that's used by humans goes to agriculture to grow food. A lot of that goes to irrigated agriculture, where we take the water out in dry seasons and we use it to irrigate crops. That irrigated agriculture is absolutely vital for food production. Only 18% of the total world's cropland is irrigated. But, that 18% of the land produces 40% of the world's food. It's absolutely vital for meeting the food needs of the world's growing population. Yet, much of the water that's used in agriculture is used inefficiently. We could grow far more food with the water we're already using.

One of the big challenges facing many countries is that they do not have enough water internally to meet all of their needs for water, in particular in the agricultural area. There are 18 or 20 countries today worldwide that don't have enough water to meet the food needs of their own populations and so they buy food on the world market. And when they buy food on the world market, they're also buying water. They're buying the water that some other country used to grow that food. Some people refer to this as virtual water and in many parts of the world, especially the Persian Gulf in the Middle East where water is very scarce, enormous amounts of water are actually, in a sense, imported in the food that is imported into those countries. And that's a reasonable thing to do if the markets are set up to do it, but it's also an indication of the challenges that are facing us as the world's population grows from six and a half to seven and a half, to nine, to maybe even eleven or twelve billion people.

Water is a huge international issue but it's also an enormous issue here in the United States. We have, in a sense, two different countries. We have a humid, wet eastern part of the country and we have a very arid, dry western part of the country. Each region of the country has different kinds of water challenges but those water challenges are, in many ways, getting worse in part because of neglect of our federal government.

In the western United States we have enormous amounts of irrigated agriculture but one of the things that that leads to is over-pumping of ground water. We're using in many parts of the country ground water faster than nature naturally recharges it. Ground water levels are dropping or ground water quality is decreasing. That's simply not sustainable.

We are not going to be able to do that *ad infinitum* into the future. But we also fight over water. The Colorado River, for example, is shared by seven states in the western United States and Mexico. We have a treaty with Mexico and there are serious political disputes about how we manage those shared water resources.

In the United States we think of water as a local issue and it certainly is. We sometimes think of it as a state issue and it certainly is that as well. But interestingly, in the United States it's also an international issue. We have a northern neighbor and a southern neighbor, Canada and Mexico, and ironically, we have alienated both of them at different times over our water policies - over the Great Lakes with Canada and especially over the Rio Grande in the southern border of the U.S. and the Colorado River, which flows from the U.S. into Mexico. We have a treaty with Mexico over both the Rio Grande and the Colorado and they're supposed to give us water in one (the Rio Grande) and we're supposed to give water to them from the Colorado in the other. But, those commitments have not entirely been met on either side. In particular drought and growing economic development has really stressed the ability of both countries to meet their international commitments.

Well, to further complicate the hydrologic cycle, the complex way nature delivers us water, is the issue of climate change. Global climate change is a real problem. We're already seeing evidence of global climate change and, among the most significant impacts will be impacts on the water resources of the world and on our own local water resources. In a sense, the hydrologic cycle is the climate cycle, of formation of clouds, precipitation and storms, runoff in our rivers and streams. That's the hydrologic cycle and it's also the climate cycle. As the climate starts to change, or continues to change, in the future we're going to see changes in precipitation patterns and when and where we get water.

We're going to see very important changes and dramatic changes in snow dynamics. Much less of what falls out of the sky is going to fall as snow and more of it's going to be rain. That's going to especially affect water resources in the western United States. And water managers are not prepared for that. We are trained to assume that the future is going to look like the past, that the same pattern of what we got in the past is what we're going to get in the future and climate change is telling us that that's no longer true.

I believe that our water problems are big. I think they affect every aspect of our life and I think in different parts of the world, even in the United States, they're getting worse. But I'm also optimistic because I think there are solutions to these problems. I think if we can muster the incredible technological prowess of our brains, and the diplomatic and political skills that we have worldwide, I think ultimately we can solve these problems.

Water is both an economic and a social good. We pay for water and we should pay for water. But water is also a social good. It has cultural values and social values that you can't put monetary figures on. One of the challenges we have is balancing these two things, balancing economic and social values for water. Ironically, one of the new challenges facing us is the very rapidly growing use of bottled water. Bottled water is

enormously expensive. It's thousands of times more expensive for a gallon of water or a liter of water than is high-quality, good municipal tap water, which is what we have in the United States. Yet, bottled water is growing very rapidly. Sales are growing. Use is growing, in part because I think of fear that maybe the water quality that we get out of our taps isn't that good. I think the challenges around getting basic needs for water met without going to a commercial model of bottled water are pretty important.

It's ironic that some of the poorest people on the planet pay the most for water. In the richer countries we're used to getting water out of taps, very high-quality water, and we pay, hopefully, reasonable rates for it, appropriate rates for it. But in the poorer parts of the world where those kinds of municipal systems aren't available, the poorest people are paying an exorbitant amount of money for bottled water, often of dubious quality, or water brought in by a private tankers, often again of dubious quality. The poor are willing to pay for water but right now often they are being forced to pay far more than they ought to.

The amount of water that people use varies enormously from place to place. The United States and Canada are some of the largest users of water per person, in large part because we have enormous amounts of irrigated agriculture. Western Europe uses much less water per person, in part because they have less irrigated agriculture, but in part because they're less wasteful. They're more efficient at using their limited water resources. And there are parts of the world where much more water needs to be used per person, where they don't use enough to meet basic human needs, to meet the health requirements, to do the kinds of things that societies want and need to do with water. There are these great disparities in both water availability and water use and reducing those disparities is a major challenge.

The issue of security has concerned us for many, many years, but only recently has the issue of the relationship between environmental problems and resource disputes really come into the security debate. We now believe, we now understand, that in fact that our security is as threatened by the way we use resources and the way we affect the environment as it is by traditional competition between the super powers. In fact, the era of super power competition has given way to an era in which security is a much broader problem including issues of resources and the environment.

Well, there are many disputes over resources and over environmental factors, but probably the most important risk to our security comes from disputes over shared water resources. Water resources are very widely shared; half of the land area of the earth is in an international river basin, a river basin that's shared by two or more nations, and as populations grow and as our economies demand more and more water, we're beginning to see growing numbers of disputes over shared water resources. We're seeing disputes in the Middle East, and have for centuries, over water. But increasingly, we're seeing disputes in southern Africa, and we're seeing disputes in Asia. Even between the US and the Mexico tensions over water are growing not shrinking, and the risk is that in the future these kinds of threats to security will get worse.

In the past, most of the disputes over the water were conflicts over access to water, and the use of water as a tool during war. But increasingly, what we're seeing is disputes over water as a tool of development, and we failed in the 20th century to provide basic water services for billions of people. And I think this one of the great challenges in the coming years in the water area. It's how to provide these basic human needs for water and reduce the risks that there's going to be fighting and violence over the failure to provide for those needs.

India and Bangladesh have a dispute ongoing over water, it has been going on for many, many years. The Bramaputra River, which flows out of the Himalayas, is actually shared by six countries, but ultimately it flows through Bangladesh onto to the flood plains of Bangladesh and provides water for tens of millions, perhaps 100 million people in Bangladesh. India and Bangladesh have a dispute over the Faraka Barrage, a dam built by India just over the border from Bangladesh in which India diverts water for irrigation and Bangladesh has concerns that they will not get the water they need when they need it.

Conflicts over water, especially in the Middle East, go back 5,000 years. There are stories in the myths and the legends and the history of the Middle East, going back to 3,000 BC, of disputes and violence over the limited water resources of the Middle East. And even to this day, water is a fundamental component of the dispute between Israel and Jordan, and Israel and the Palestinians, and many of the other parties in the Middle East, between Turkey and Iraq and Syria over the Euphrates River. Water has been used as a weapon and as a tool, and it's a fundamental source of dispute.

But water is only one component of the dispute in the Middle East, and water will have to be integrated into all of the negotiations, all of the peace talks. In the treaty that was signed in 1949 between Israel and Jordan, water is a fundamental factor. There is an agreement between Israel and Jordan to allocate waters between the two countries. There is now a mechanism for at least discussing, or beginning to discuss, disputes over water, but it's still an unresolved problem between the Israelis and the Palestinians and between many of the other parties in the region.

Haiti is a place where all of these environmental, economic, development and political issues come together in a very dramatic and a very terrible way. The Haitians removed their forests over the last several decades and that led to the loss of soils from the hills, which then led to the collapse of the agricultural economy and ultimately to the economy as a whole. And the implications for water resources are equally staggering. The population without access to clean drinking water and sanitation services is very large in Haiti. Water-related diseases are running rampant in Haiti, and if we cannot get a handle on the water problem, we're not going to be able to get a handle on the economic development problem as a whole. Haiti is really an example where all of these problems come together.

Why should we care about water conditions and poverty and environmental problems in developing countries? It's fundamentally tied to our own security. The health and well-being of the world's populations are increasingly apparent in relationship to our own

security. The fact that we were forced to send--we and the world community--were forced to send in peacekeeping troops to Haiti or Somalia, where much of the political instability is related to environmental degradation and the failure of economic development should be a warning sign to us. If we don't address basic human needs for water and for economic development, then we're going to see political instability, and disputes between the rich and the poor, that have spillover effects that cross oceans, that reach to our own shores. Water is one example of that, and probably one of the most critical examples of that, because it's such a basic human need. But it's tied to this broader issue of global well-being and development.

South Africa is an interesting case from the water point of view, because it's one of the parts of the world where real efforts have been made to rethink water policy and basic water needs. Also, it's an area where there are disputes internationally over the water resources of the region. When the Apartheid government fell, it was an opportunity for the new government first of all, to throw out the old water law and to really focus on meeting basic needs for water for the tens of millions of people that hadn't had those needs met by the Apartheid government. And the new constitution and the new national water law in South Africa guarantee basic water needs for humans and basic water needs for the ecosystems as the top priority.

At the same time, there are a series of disputes in southern Africa among Botswana and Namibia and Angola over water resources of the Okavango River, between South Africa and Namibia over the Orange and Lesotho Rivers. There are five rivers that are shared by South Africa and Mozambique, and there have not been satisfactory resolutions of those disputes. They haven't led to violence yet, and there's a very good chance that they'll lead to cooperation and not violence. But it's a great example of where the risks of shared international water and the problems with human development come together in a dramatic way.

There's a long history of violence and conflicts over water resources extending back many years. Increasingly, even before the terrible events of September 11th, we've seen examples of the connections between terrorism and water systems where terrorists have targeted water systems. The risk is that increasingly, we're going to see water resources and water systems being used as targets and tools of terrorism. We have to think not just about preventing terrorist attacks on water systems. I think ultimately we won't be able to prevent all terrorist attacks, but rather, we need to think about what we can do to minimize the impacts of those attacks, how to make our infrastructure less vulnerable, how to recover quickly when terrorist attacks do occur, how to monitor our water resources regularly to insure that clean drinking water remains available for all of us all the time. I think that there are things that we can do, but before September 11th, we weren't thinking about them and we weren't doing them.