

Discussion continued

Seckler: To me, a major issue is, are we going to have to get into large-scale water development programs in the future, whether large dams or whatever, or can we by these alleged efficiencies avoid big investments in water development programs?

Gleick: There is a lesson from the energy situation of 10 to 15 years ago when we started to hear from Amory Lovins that we could eliminate all projected future increases in demand for energy and in fact probably close down all the nuclear power plants in the world if we were much more energy efficient, while the utilities were saying we need to build thousands and thousands of megawatts of additional power

plants to meet expected growing demand. We are now, 15 years later, still debating the issue except that it is clear that at least some of that benefit is there. Now electric utilities for economic reasons are becoming aggressive in the search for efficiency improvements in very innovative ways - ways we never would have thought about 15 years ago. I believe that in the water area the answer is the same, but we are 10 years behind. On the one hand, people are saying there is enormous potential for water conservation and water efficiency improvements; on the other hand, we have the same supply-side orientation, and we are just beginning to think about ways of matching the two. I think we need to be equally innovative. The question of economics is important, but I don't think there is any doubt that we are going to find mechanisms, both institutional and economic, and resources that we didn't expect.

Levine: One of the problems is that, by contrast to the agricultural sector more generally, the irrigation sector is not research oriented. The agricultural sector has built an effective working relationship between the research community and the users at a whole range of levels. There are both public and private research activities that feed into that system. But there are essentially no irrigation research institutions. The few that are associated with irrigation departments are really physical model builders of dams and spillways and things like that.

So there is no research tradition, there is essentially no research capability, and there is a great deal of suspicion. Using research to change the irrigation subsector is going to be much more difficult than in the case of the agricultural sector. The time in which a discovery is in some way utilized now in the agricultural sector is very small. The rice variety IR8 was introduced about 1965. Within something like 7 years, 60 percent of the Philippines was in the new varieties. In a country with islands, with multiple languages, with a lousy extension system, the farmers picked that up very rapidly. I don't think you can expect irrigation departments or ministries of water resources to respond anywhere near that rapidly to anything that is found through irrigation research.

Postel: If you look at northwest Texas or where there have been certain fairly dramatic changeovers in technologies, they have come pretty quickly once they have been demonstrated. The LEPA (low-energy precision application) technology and the surge-valve technology spread very quickly.

Levine: You are talking about on-farm technology. On-farm technology is basically handled by the agricultural system.

Postel: But it is an improvement in irrigation technology that has spread.

Levine: It will be much more dependent in developing countries because you are dealing with 1 - or 2-hectare farms. The research will be filtered in some way through a government organization.

Rock: Is this because technology is stagnant in irrigation? What you have just said is the most appalling thing that I have heard today. It suggests that institutionally you have within the public sector a relationship with the private sector that is just build, build, build.

Yudelman: The strategy in most lending agencies now is not to invest in new dams because of the rising costs of new investment, the low price per output, and the problems of implementation. The focus is now on the rehabilitation of existing systems. That may be a mistake because it takes up to 15 years to develop a sizeable system, and you can create a hiatus. Having said that, I think that in certain countries - India is one of them - the dams will be built regardless of what is said. If you look at the potential for expanding irrigation, the world's biggest irrigated areas are in China and India, the two most populous countries in the world, each of which will have 1.6 billion people by the year 2020. The potential for expansion in India is still quite considerable. Even in China, you can still expand by 25 million hectares. But you have to start getting to big trans-basin systems. You are going to have to move water from water-surplus areas to water-deficit areas. These are going to be very expensive investments.

"If you look at irrigation systems being built in India today, the technology in those systems would be perfectly recognizable to a turn-of-the-century irrigation engineer."

Svensen: There are two points that I would like to pick up on. One is technology and Levine's argument that there really isn't any irrigation research capacity, which I think is true at least in the sense of irrigation management, outside of IIMI. Mike Rock's being appalled at the possibility that there has been no new technology developed that would make irrigation more efficient and more effective over the past few years is an interesting point. If you look at irrigation systems being built in India today, the technology in those systems would be perfectly recognizable to a turn-of-the-century irrigation engineer. He would be at home with the manuals, with the gates. Technology development has been mostly in the private sector, which is what somebody was saying. It has been mostly in the West, and it has been driven mostly by the need to reduce, first, labor costs and, then, energy costs. You don't really have those pressures in the developing countries.

Yudelman: What about pumps?

Svensen: You pay for pumps on a per-horsepower basis in India. So it doesn't matter how long I run the pump. If it is 5 horsepower, I pay so many rupees.

Yudelman: That has been a big change.

Svensen: It used to be metered. But, how shall we put it, the transaction costs and the leakage were such that they couldn't continue that.

Groerifeldt: You are talking about public tube wells?

Svensen: Private tube wells. Let me come back to this analogy with the electrical distribution system. There are some similarities, but there are also some important differences. In this country, electricity distribution systems are organized as a regulated public utility. It has to take in income and cover its own costs; its rates and rate of profit and so forth are regulated. That model has a good deal of promise in the developing world, but it is not present yet in very many cases. The Philippines has experimented with it. You find cases scattered throughout China. You find it in some East

Asian countries. In general, that analogy is a powerful one because you have to focus not just on the supply and demand questions but the way in which the supply agency is organized so that it will respond to pressures for improving efficiency of use.

Rogers: I just want to go back to whether we need to think about big projects in the future. I don't see that, and I don't see it for the reasons that Peter Gleick said. It's analogous to the energy sector. Nobody is building nuclear power plants, not because they are bad environmentally, they stink economically. You can't afford to do them. This is what we are seeing with big dam projects or dam big projects. You cannot justify them in economics. Where you do see good returns are in small-scale groundwater development and small projects, which are all very local level, typically done by private individuals and they are still not paying the true opportunity costs. They are not paying the rent for the water, but they are paying the cost of capturing the use, and they tend to be very efficient. I think what we see is induced efficiency. That's what's going to happen. Some of these big projects will linger on like Three Gorges Dam in China, but that is the end of the road. We certainly won't see any big ones.

Blake: Isn't Three Gorges a bit different though? China has a "socialist" government that doesn't feel it needs to be guided only by economic costs.

Rogers: I would say that there are some basic laws which apply whether it is Beijing or Kansas. I think if you price it right, Three Gorges doesn't look very good.

Yudelman: I think you have begged the question. You have stated as a fact that large projects are less efficient than the smaller little ones. I say it is a hypothesis.

Gleick: I agree that the U.S. situation on the energy and the water side is not directly analogous to the international arena although we perhaps would like it to be. There are some useful analogies. One of the problems is that international aid agencies that tend to fund large dam projects or large irrigation projects, don't, as a matter of course, look at alternatives in the same way. They are not required to say, instead of spending \$3 billion on this dam project, what would \$3 billion buy in some other small-scale project or water-efficiency projects, or something like that? The same question, incidentally, applies in international aid projects for energy. Now, for the first time the World Bank is being forced to look at conservation investments in the developing world as an alternative to a new 1,000 megawatt plant. They are beginning to fund conservation investments in developing countries, too.

The question: Why has progress been made in the energy area and how might it be made in the water area? Part of it is that the environmental costs of massive fossil fuel projects and big nuclear projects have become more evident. The economics of big projects has become less favorable. The nuclear industry likes to claim that environmentalists derailed most of these projects, but the reality in the United States is that it is the economics. Some people say it is because of all these regulations that environmentalists have imposed, but in fact that may or may not be true. The fact is the economics is not favorable. Public opposition is also very important. I think there is an analogy there with major water projects internationally. It is slowing them down.

There is also the question of reliance on imported supply. Countries don't like to be dependent on external sources of oil, and that has pushed the pursuit of more domestic alternatives and often renewable sources of supply. One might think about the extent to which one is reliant on external sources of water. If Egypt's choice is insisting that the Sudan build the Jonglei canal or that Ethiopia not build dams on the Blue Nile and is willing to go to war for it, they might look instead at the cost of improving the efficiency of the water they are using now. There are other examples as well in Israel and throughout the Middle East. It is a big question in many other parts of the world where your source of supply is outside your borders. It might be cheaper for a variety of political reasons and military reasons to look internally first.

Rock: Haven't you left out the biggest factor on the energy side, which is the quadrupling of energy prices. The impact of that on demand reduction in the U.S. has been enormous. I don't know that there is an analog for water anywhere in the world.

Gleick: I didn't mention it because water is priced more often in the U.S. than it is in most of the rest of the world. It is a powerful mechanism, absolutely. To the extent that water can be properly priced, or priced at all, that would be a major incentive to shifting.

Rogers: On that point, most people don't realize that water use in the United States has gone down drastically.

Gleick: Slightly.

Rogers: We are using less than we were in the late 1960s.

Gleick: Slightly.

Rogers: Think about the growth in the economy since that period, water use per unit of output is way down-comparable to the reductions in energy. There are tremendous changes and we haven't even started to seriously push the price. There is a long way to go in countries like the United States.

Seckler: I think the analogy with power is dead wrong. If I have an inefficient power system operating, the waste energy really is wasted. It's turned into heat and dissipates. If I'm wasting water in an irrigation system, that water is not going into evaporation mostly. It is going into some other use downstream, The whole trick of the matter is to ask, if I improve the efficiency of irrigation in this dimension or water use anywhere, is that going to yield a net benefit over what I am losing somewhere else in this system downstream? Sometimes the answer may be yes and sometimes it may be no. Water is an entirely different substance in this regard.

Also in irrigation you probably have less chance for factor substitution in crops. You can't save much water by going down the yield curve. You are going to hit a yield and it takes so much water. If you take that water away, you will lose most of your yield. It isn't, in my opinion, economically profitable to try to economize water by reducing yields in that sense. You can't substitute water for fertilizer very well. There is some margin for that. So the factor substitutability is low.

The main thing that I fear is that even if there is some scope for gains in efficiency, are they going to be anywhere near the amount that we need to meet these food production targets that I am talking about? Can we save enough water somewhere to double crop production in the world? That is the question we have to ask ourselves.

Gleick: That is an excellent question. I think you are wrong on the energy side.

Seckler: My answer to that is, yes, you can if you want to do what Peter Rogers does and turn the market loose and we will get food prices up four or five times. Then, we will reduce the demand for food and we will increase fertilizer use and we will meet our demand and we will lose maybe a billion people starving to death. The other solution is that we march off into Brazil and put in some good road systems in North Africa; we can meet that food demand by tearing up the forests and rangeland in New Zealand and North Africa. That may happen.

Yudelman: In a recent report by the Technical Advisory Committee of the CGIAR, where they brought all their resources to bear and took a look at the existing systems of agriculture and the existing technologies, they simply said, if we applied what we know best right now on what is available right now, we could produce enough food to feed the existing population plus 50 percent.

Seckler: I've got a report by one of the greatest agronomists in Holland that shows that there is about 100 times more potential than we could ever use.

Yudelman: This is quite different. He was saying under optimum conditions.

Levine: This is on a little different topic. If you deal with a \$100-million project, you come out with four volumes of feasibility studies by a consulting firm, and the only question asked is, is the country good for the \$100 million? It makes it much easier on the technical staff involved. At present, however, the banks are getting around that issue by going to sector programming and leaving it up to the countries to break the \$100 million down into smaller units and smaller projects. Whether those projects are really any better in that process, no one, as far as I know, has really evaluated. That is an important issue - whether the money currently being used in the sector approaches is achieving what is expected.

Sklar: I support Peter Gleick's analogy with energy. We are not talking about wasting energy. I don't think we are talking about wasting water. We are talking about wasting money. That is where they are analogous. Pacific Gas and Electric in California is finding it is virtually cheaper to give people light bulbs and insulation than it is to buy and build new generating facilities. The City of Denver found that it is virtually cheaper to buy and give people new toilets and shower fixtures than it was to build the Two Forks Dam. This change is happening across the United States and other northern countries, I believe. I am heartened by Peter Roger's optimism about the withering away of the big dam project. While that seems to be true in this country - in fact, we have come to the point where we are taking down some very large dams like the ones on the Elwha River in Washington State in order to restore fisheries, which turn out to be more valuable than the power, I don't see that happening around the world. The International Commission on Large Dams says that 200 large dams - 50 feet or

higher - are being completed every year and that the kind of economic accountability that has taken away the subsidies that drove many of the projects in this country hardly exists in developing countries and the institutions we have been talking about. The incentives for quantity over quality at the World Bank, for example, are very strong and are not withering away, though we do see some cracks in the facade as reports like Wapenhans' internal bank study illustrate the unsustainability of this.

Another point on large projects has to do with sustainability. One of the reasons we don't see many big dams being built in this country is that the good sites are used up. I don't think environmentalists can take as much of the credit, or of the blame, depend

ing on your point of view, as is ascribed to them

for the demise of big dams in this country. Engineers say, if we only had a few more sites, we would stay in business a little longer. Those sites can be used up everywhere. Unfortunately, many of these projects have a finite life and, on the sustainability issue, what are we going to do when these storage reservoirs are silted up? We can't store the water. Are we going to tear the dams down, remove the silt, and build a new one there?

Are people looking at the cost of decommissioning in the analysis of proposed projects? Whether we allow every good site to be built in developing countries is still a hot topic. I think this is a top advocacy priority - bringing economic accountability to decision making, leveling the playing field so that the smaller alternatives can at least be tried. It is hard to analyze 100 \$1-million projects. We have a lot of data on the problems that come out with \$100-million projects. Let's try these things and see what happens. In a sense we don't have a lot to lose. We shouldn't let narrow institutional concerns get in our way, such as people at the World Bank saying, we don't have the staff and it is a lot easier to do it this other way.

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Groenfeldt: I am glad that this discussion has shifted to the large versus small because that is the repetitive theme at least among the donors who are still in irrigation—not AID. I agree with Monty Yudelman that the World Bank has already decided, at least in Africa, not to do large-scale irrigation projects. It has nothing to do with the virtues or problems of large-scale projects. It has to do with the politics of the environmental community and the cost to the bank politically. We need to have a little more rigor in our discussion about how to compare them, if not to answer the question, then at least to pose the question more rigorously. Small projects lend themselves more to local involvement—it is easier to find a national contractor to build a small dam than it is to find one to build a huge one—and to local participation in design decisions and the eventual operation of them.

I am thinking of another case in Thailand, the Mae On Project, where an upstream reservoir fed 11 downstream systems. Part of the project was to integrate the management systems, the human systems, and the irrigation leaders for each of the existing downstream systems into a committee that advised the Royal Irrigation

Department on the operation of this medium-sized dam. You are not going to do that in something on the scale of the Narmada or Three Gorges. So there are many developmental payoffs and benefits to smaller structures because they can support things that I associate with development goals, such as local political self-reliance and developing management among local people rather than the government bureaucracy. I don't think they lend themselves to economic analysis. They do lend themselves to development discussion. I would be happy if we ended the meeting with more sense of what are the trade-offs or how to frame a discussion that tries to compare large versus small, even if we can't answer it.

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Meinzen-Dick: One barrier to many small projects for an agency like the World Bank is the need for an institutional intermediary to handle them. We need to be careful to ask, what is that intermediary institution and does it perform any better than the irrigation bureaucracies? We know they have problems in the way they function and

with a lack of accountability. What about other institutions?

That brings me to an underlying theme: incentives for better performance. At each level, what are the incentives for better performance of the irrigation institutions as a whole? Is financial autonomy the incentive that we need? What are the incentives for technological investment or conservation on farms? Is it water pricing and higher value? A helpful angle of attack in thinking about how to achieve these changes is to pay attention to how we make it in people's interests to make the changes that we see are optimal.

Moore: Dave Seckler's question about whether the gains to be made through efficiency improvements are close to what we need to satisfy new demands is ultimately the real question. If we advocate not building more large dams, we have to have some alternative that is going to work. We still seem to have some basic disagreement about whether alternatives will work or not and also a difference in perception about whether that is already happening or not. Some people say the World Bank is not building new projects, and they are shifting their approach to rehabilitation. Someone else says, no, in fact they are building many new projects. I'm getting more confused rather than less. It seems we may not resolve this question of whether there are real water losses to be recaptured. There seems to be basic disagreement about that. I'm somewhat surprised. Even with that, what Ruth Meinzen-Dick said is key, which is, we need the incentives for better performance at all levels. We have talked about trying to get incentives within donor organizations so that there isn't the pressure just to lend even for projects that aren't going to be successful. I wonder whether people from the research community see that working with advocacy organizations can be valuable for turning their ideas into pressure for institutional change. That is, from my point of view, where we are not working together, even when we are talking about the same ideas.

Levine: In the Ogallala Aquifer - if that's stabilized after a number of years of decline - the analysis was that two-thirds of the reduction in the water use has come

from areas going out of irrigation and one-third has come from improvements in technology. That is in a situation with lots of monetary pressure because of the cost of pumping. It has been the going out of irrigation that has made the major saving.

Gleick: I wouldn't say that is an argument against efficiency improvements.

Levine: That's what you are talking about and that puts you face to face with the food issue.

Rogers: I want to get back to small versus large and the feeling that we didn't know what is better. We do. In the United States, the average time to complete a big water

project is 28 years from authorization to turning

the tap on the other end. Time is money in these things. Think about discounting. Think about trying to justify this using any reasonable project evaluation technology. It doesn't matter how big the benefits are. At some point in the future, you are going to wait 20 years before you get them.

Other countries are quicker building them - 10 or

15 years is typical time to build a big project. How

long does it take to build a tube-well project? A guy goes out with a drilling rig and 3 months later he is pumping water. You get benefits right away. There is no question in my mind that the big projects cannot be justified economically at the rates of return that we are seeing for food production.

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Seckler: Nobody is going to argue against pump irrigation. Any time you can pump, do it and don't do anything else. Okay, we can clear that one out. The question is, what has happened historically? For 20 to 30 years, we have had a worldwide policy in the developing countries of keeping food prices down, for obvious political and humanitarian reasons, by doing things like investing in irrigation and creating, if you want, surplus capacity in food production. That, combined with the developed countries' interests in protecting the farm block and dumping enormous amounts of commodities on the world market, keeps prices down. The long decreasing trend in food prices in world markets is easily explainable by the \$100 billion per year of subsidies from the European community and the U.S., the dumping practices, and deliberate overbuilding to keep food prices down. That is why these projects won't make economic sense if you assume that the prices are going to stay the way they are. What is going to happen very quickly is that as we back off our subsidy and dumping programs and the World Bank leads everyone into pulling out of fertilizer subsidies and irrigation, we will see a continuous growth in food prices over the next few decades, which would then make these projects look good.

Rogers: Even if it doubles the price.

Seckler: No, if the rate of growth of prices is the same as your discount rate, then you are okay. Six percent or whatever you want.

Rogers: Ten percent?

Seckler: Let's talk real terms: 4 percent. Then, everything looks all right. What I am saying, in other words, is don't be deceived by the economics here.

One last point. The World Bank is just finishing an ex-post evaluation of their irrigation sector investments, and they find, much to their amazement, that their big projects turn out to be better than their little projects. It is pretty much across the board, not only in economics but in the performance and everything else.

Levine: Why?

Seckler: They don't know for sure, but the results are better in the larger projects

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than the small. As much as I like small projects, and I do, it isn't surprising because the cost per hectare or per unit of product in the small tank project is two or three times what it should be in a medium-sized project, much less a large-sized irrigation project, and the management, the hassle factor, and the accidents you can have are a greater burden. I love small projects and I think Peter Gleick made some good points about why they are good to do on other grounds, but economically speaking there is no question they are more expensive than larger irrigation projects.

Gleick: Some of the environmental impact of hydroelectric dams and reservoirs is a function of the energy produced by those systems - large systems versus small systems. As you might imagine it is very complicated - how you measure it, what you measure. I suspect, although this isn't my field, it is even more complicated for irrigation systems.

I want to say one more thing about efficiency. In the United States, in what was the Soviet Union, and in Western Europe, there has been a tremendous growth of GNP in the last decade and a half without the same growth in water use. That decoupling for the first time is a strong argument to me that we can produce more things with less water - that we are becoming more efficient in our water use.

It is an area ripe for study. How has it happened? Why has it happened? In California, industrial water use - water use per unit output of goods in specific sectors - has gone way down, not because the price of water has gone up all that much, but because there is pressure on supply and water quality as well. There are a number of drivers, but the fact is that industrial use of water has become much more efficient in California even without the economic incentive. There are technology substitutions. There are, in a sense, input substitutions comparable to the energy field that I think are interesting to look at.

Whether efficiency improvements are available in a sufficient quantity to meet future demands is an interesting question also. We have a project at the Pacific Institute to look at efficiency improvements in different sectors and what that means for freeing up water and how efficiency improvements should be separated from sectoral shifts. It is

one thing to go to drip irrigation from flood irrigation. It is another thing to stop growing alfalfa in California and shift that water to a different crop or to shift that water to the urban sector. Those shifts also have the potential to free up a lot of water, but then society has to decide how important is it to grow alfalfa. We may not be able to afford to pay for the water if we are fighting between the farmers and the cities. The cities can pay a lot more for water. We may decide as a society that we would rather have the crops. Where does that cut off? Are we going to shift all the water to the urban centers and not grow anything? Sooner or later you get hungry.

Ellis: Peter Rogers, on the point that the U.S. water demand has not substantially grown since 1960, why has that occurred? Is there anything applicable there to developing countries?

Rogers: The *World Development Report 1992*¹ had an interesting hypothesis about resource use and environmental quality and GDP. It showed that there was a U-shaped curve. It seems to work with almost everything. GDP keeps on going up. Resource use and pollution and things like that go up and go up and then they reach a peak and then they come down. Certainly the OECD countries show it, the U.S. shows it, even on things like carbon dioxide, which is a surprise.

Levine: Except that the U.S. is a little blip at the end.

Rogers: Certainly. What it says is that for the developed countries and for countries that are up to a certain level, we will expect them to use less and less of the resources and keep on improving their GDP. It won't go on forever, obviously. The real problem is the countries below some critical income level that need to use more of everything in order to get their consumption levels up to a situation where they can afford the luxury that you don't have to actually legislate environmental stuff. As people get wealthy, they choke on the atmosphere, which when they were poor they were quite happy to breathe. So what you see is a luxury. The demand for environmental services increases once you go above a certain threshold level. This is what got Larry Summers of the World Bank into trouble last year when he said you don't have to worry about the environment, worry about people's incomes. If you can get income in China above \$3,000 per capita, lots of good things are going to happen worldwide with respect to the environment. The trick is get there. What does it take to get there? Is it really \$3,000? Can you actually shift it by doing some other things? One of the things is for us to export sufficient technologies to a society that is not ready to buy them, but to say, we are going to give you these technologies and we are going to subsidize your use of them because this is good for the environment.

There is also a disembodied technical effect. Capital stock is being replaced all the time. If you are in China and you want to buy a paper plant, you don't buy a paper plant like the paper plants we have in Maine and in Georgia. You buy a Swedish paper plant. Why do you do that? Because it is very efficient. It produces paper and costs

¹ World Bank, *World Development Report 1992: Development and the Environment* (New York: Oxford Univ. Press, 1992).

less. It also uses a lot less water and a lot less energy. So what you see is a substitution. Even without going out to save things, you are actually saving them.

Gleick: I would like to disagree with one aspect. China just bought technology to build refrigerators - a billion refrigerators - something absurd. The technology they bought was not the most efficient Swedish technology. It was a cheap technology that turns out to use a lot of chlorofluorocarbons and a lot of energy per unit of cooling.

Rogers: That's one technology. But in other technologies, the water-using ones, energy is the thing that people look at. They don't look at water costs. It costs a hundred times more to keep water than to buy it.

"Environmental NGOs tend to be concerned that large dams being built and the amounts of money they suck up have a kind of totalitarian effect on their societies."

Rock: Isn't another caveat that all of the breaking of the linkage between environmental quality and income growth in that World Bank report was on the industrial side? For agriculture, there was nothing in that report about breaking linkages.

Rogers: No. They just plotted the data they had. If you look at the water use, I'll bet that you would see the same thing.

Yudelman: Another World Bank report about agriculture in the Middle East discussed the impact of the shortage of water on the technology that is being used, and it showed a definite shift to drip irrigation and other systems. It's there. It's taking place.

Parcells: Environmental NGOs tend to be concerned that large dams being built and the amounts of moneys they suck up have a kind of totalitarian effect on their societies. An example is a dam being built in Nepal where the NGOs claimed that its cost was five times the GNP of Nepal. Their view was that in an effort to increase democracy in these countries, it becomes a frightening problem that these mega-structures dominate the economies and can suffocate a democracy, community participation, and so on.

Another issue on large dams is national security - national security meaning vulnerability to earthquakes or other types of natural disasters, plus the possibility of actual enemies coming in and destroying these large dams such as in South and North Korea.

As the chair of the Everglades Coalition, I have been spending much time working at the major replumbing of the Everglades. In 1948, there was a Central and South Flood Control Project, which made investments in canal systems and pumping systems for prevention of floods but also for agricultural purposes. Ironically, there is now interest in taking the Kissimmee, which was channelized 20 years ago at the cost of \$30 million, and putting it back into its natural state for \$400 million. So in this cost issue, it seems to me that inherent in big dams is the possibility of big mistakes. At a time when you want to be more innovative and more flexible, large investments in these structures can have painful consequences 30 years down the line if you have to take care of a particular problem. From a community development perspective, we would like to see more Model T's and less large Cadillacs. I would like to see the World Bank

and some of these other financial institutions find a mechanism to produce a lot of Model T's and not the big Cadillacs.

Levine: The questions that I get when I raise some of these issues with government people overseas are: Would you give up Grand Coulee? Would you give up Lake Mead? Would you give up the large dams that formed the basis for development in the Western United States? I have a hard time answering those questions.

Gleick: Another way of asking that question is, is Phoenix or the system sustainable? What is going to happen in a hundred years to a place like Phoenix?

Levine: Nothing is sustainable to infinity. When you talk sustainability, you have to put a time frame on it. Is it sustainable for the next 25 years, for the next 50 years? What is a reasonable way for you to predict? So whether Phoenix is going to be here 100 years from now, no one can answer.

Moore: But if you had the Gila River Indian community in this room or the Confederated Tribes of Warm Springs in Oregon, we probably would be having a very different discussion about that. They probably would say, yeah, we would give up those dams. So there are other legitimate interests involved.

Gleick: It's a question of whose values count.

Levine: We have the same thing in talking with our Brazilian colleagues on sustainable agriculture. They say, you can't even solve your Oregon spotted owl problem, what are you talking to us about the Amazon for? That is a hard thing to answer in those countries.

Yudelman: On the large dam issue, I think each circumstance varies. There is a large impoundment project taking place now in Lesotho. It is very mountainous and has a large surplus of water that is running to the sea. The only export prospect is water. So that project, which is going to cost several hundred million dollars, is being designed to capture water to export it to South Africa. I believe the economic analysis shows that it is a feasible, sound project. I don't know how many years it is going to take.

Peabody: In reference to David Seckler's comment regarding project scale and impact, even if the World Bank report shows that bigger projects are better than smaller ones, that may or may not mean anything. One of the things that is clear is that the bigger the project is, the bigger the scare of disaster or of having it go wrong. Also, the supervision and design investment will be much greater than in the smaller projects. Smaller ones are scattered: They are not supervised as closely as larger ones. They are often make-work projects, and they are often not finished because they are the last ones to get scarce funds. So if it is harder to see the impact, I would say that is not surprising. Is that real or is that a part of the institutional culture - a reflection of the priorities of the engineering establishment, rather than those of water users? The issue of what shows up to be better - bigger or smaller - depends on how you look at it.

Postel: I want to get back to the reasons the demand for water in the United States has slowed and somewhat dropped back. In the U.S., it was a combination of slow

downs in irrigation expansion in certain areas, but, probably more dramatically, changes in industry. In Japan, the United States, and Germany, we have seen dramatic increases in water productivity in industry largely driven by pollution-control laws. It becomes more economic to recycle within the factory rather than to discharge wastewater that has to meet strict pollution-control standards. So, for example in Japan, we were seeing \$21 worth of output per unit of water delivered to industry in the late 1960s and now we are getting \$77 - a tripling of industrial water productivity in two decades. The figures are similar for the United States and West Germany. You see that trend pretty uniformly when you begin to adopt pollution-control standards in countries.

"Nothing is sustainable to infinity."

But look at water use globally. It has tripled since 1950 and per capita use globally has increased 50 percent. If you play out that trend and multiply it

by population, you are looking at a much quicker tripling than we have seen since 1950. So where the inverted U begins to turn becomes a critical question with regard to the environmental damage done in between the point where you are still increasing versus where it starts to turn down, given the increase in population we are going to see between now and 2030. Can we get that change in the curve sooner or do we need to wait until you get an income level of \$3,000 per person? Given the population momentum we know we already have built in, that to me is problematic when you look at what that means for growth and water use globally in an absolute sort of way.

Just a quick point on the Phoenix issue. It is a good example of where the economics of a large system hasn't played out well. Farmers in Arizona can't afford tap water now. They are not able to pay for it. It is a huge government subsidy to a project that is now not being used in the way it was intended.

Levine: I said when that decision was made that there wasn't going to be any of that water used for agriculture except by the native Americans. It was all going to end up in Phoenix and Tempe and so on. It was absolutely clear that the economics was going to drive it that way, even though agriculture was what people were talking about for the rationale.

Seckler: I want to pass on a point of information on a technological change in big dams, because it relates to the sustainability issue. I was talking to one of the World Bank engineers who is working on the Three Gorges Dam, and I said, what are you going to do about sedimentation? He said, oh, don't you know, all the big dams that we are doing now have flushing systems. I didn't know this. Actually, in that one, they can in fact put tunnels underneath these dams and flush them out.

Gleick: The sediment stops hundreds of miles from the actual dam.

Seckler: I know that. Everybody knows that.

Gleick: Your engineer didn't know that.

Seckler: But your basic problem is when it starts working down to the dam. Pretty soon it gets in the turbines. That's when you stop. Right? What you do instead is flush

out that dead storage spot periodically so you don't have to shut your dam down because of it. It builds up where the backwater effect hits, obviously. That doesn't bother anybody.

Gleick: By the time it gets to the dam, the volume of the dam is gone.

Seckler: No. You flush out your dead storage capacity. The problem has been filling up your dead storage.

Gleick: I would love to see the design. This is an experiment. It is a \$20-billion experiment. It has not been proven to be effective yet.

Meinzen-Dick: David Seckler is so great because he throws out provocative comments even when he is not trying to be provocative. I am going to argue with an earlier one, which was the concession to Peter Rogers, saying that no one argues against pump irrigation. Any time you can do it, do it. The Ogallala is a good example of why you should not always pump when you can. Saudi Arabia and Tamil Nadu in India are also developing many problems. We need to think about the inter-connectedness of pump systems. When you are pumping, you may need to then generate a canal system to recharge your groundwater. And you certainly will need to have energy supply systems, which have other environmental consequences. So I don't have anything in principle against pumping, but I think it has to be seen as part of a system and this goes back to where we need some hard information about the inter-connectedness of these pieces.

Havener: In saying we would rather have many Model T's than a few Cadillacs, we need to remind ourselves that we aren't the ones who make these decisions. It is the sovereign governments that make it. Our problem is how to influence them to want many Model T's rather than a few Cadillacs. Second, remember that they too have management problems. At least they believe it to be easier to manage a few Cadillacs than thousands of Model T's. It may not turn out to be right, but the guys that are sitting in the chair say, perhaps I can manage three systems, but I certainly can't manage 3,000 systems. That's the reality as they view it.

Moore: Small cars are easier to fix yourself.

Havener: I agree with that, but the people who are making the decisions still are those sitting there in the ministry of agriculture or irrigation in Islamabad, and they are the ones that are dealing with the bankers. They are the ones that represent the sovereign government that is acquiring the loan.

Peabody: They are the same culture institutionally, as well. They represent the educated urbanized elite, who believe they administratively should introduce the modern world to their rural constituents, because they know that is best for them. They are more like the international bankers than their poor fellow citizens.

Havener: Exactly. They are looking both at the upstream problems of how to deal with the World Bank and downstream problems of how to deal with the farmers.

Gleick: That is a good point. The case of China stands out. They are not taking World Bank loans mostly and they have chosen to focus on building small dams, Three Gorges aside. They have built thousands and thousands of small hydroelectric dams over the last several decades and smaller irrigation systems, too, and manage them very well. They are a society in which decentralization has been very successful.

My other point is also a minor one. It has to do with consumptive use of water in the United States. For a book that is about to come out, I got the latest data from the U.S. Geologic Survey for 1990. Water withdrawals and the consumptive use, which is fraction of that, of course, went up continuously from the '40s through the '70s. In 1985, for the first time, consumptive use and withdrawals dropped. For 1990, it actually has gone back up again. Consumptive use withdrawals, and to a lesser extent, consumptive use have slightly increased over the 1985 levels. Having said that, consumptive use per unit of GNP and consumptive use per capita have continued to drop.

Ellis: One might assume from the combination of the statements of Sandra Postel and Peter Gleick that we really ought to concern ourselves with industrial water use rather than agricultural water use because that is where the real potential for savings are. I'm not sure that is right. It is artificial to separate agriculture from industrialization. I would say we have to look at industrial and agricultural development at the same time.

Postel: I didn't mean to imply that saving water in industry is more important than in agriculture. I was just attempting to explain the dropping off in the growth in water use in the United States. In terms of absolute water savings, I think they are larger in irrigation, particularly if you are looking at consumptive uses. Agriculture is where the consumptive use happens. There is only a tiny bit of consumptive use in most industries, although you begin to change that if you move toward internal recycling.

I want to focus on Peter Gleick's energy analogy. We haven't said much on urban efficiency improvements and urban conservation. There are a number of cities in different stages of development and in different cultural settings that have done very well with conservation as an alternative to traditional supply expansion. A good example is Boston, where there has been a 20 percent reduction in total water use in the last 5 years, which has dropped the water use back to the level that it was in the 1960s and allowed the Massachusetts Water Resources Authority to delay building a new water project. They looked at a diversion from the Connecticut or Merrimack rivers versus a conservation program. The conservation program involved industrial water audits, fixing leaks in the distribution system, and retrofit, and a big price increase. Together those measures were very effective at reducing demand. It was a way of meeting real needs in the metropolitan area that did not involve the traditional approach of expanding the supply. You can look at similar examples in many cities now. We are not at that point in developing countries. But when you look at the cost of a modern water and wastewater system---on the order of \$450 to \$700 per person - to the extent that building efficiency into the systems from the start can reduce that figure and get more from the existing system, those costs are going to come down, allowing more people to be served than would be from a traditional approach. Urban conservation is not some

thing just for industrial countries. It can benefit developing countries from the start. I don't think we have yet made that shift. It does change the demand projections.

Walker: Are there any negative trade-offs from conservation?

Postel: In an urban situation you are collecting water and storing it in a reservoir usually for distribution to a very concentrated demand in an urban setting. So, to the extent that you are relying on more efficient fixtures and more efficient industrial processes within that metropolitan area, the amount of water in that reservoir is going to go further. You won't need to go out and build another reservoir or have another diversion. You are getting more from what is essentially a fixed water supply system.

Levine: One potential problem that the water supply and sanitation people raise is that the real use of water is transporting sewage. That's where the large volume is required in urban areas. If you have sewers that are designed with flat slopes, you need certain volumes of water to make them function.

Postel: I think we have enough examples where we have gone from the 5- or 6-gallon-per-flush toilets to the 1.6-gallon toilets without any terrible effect on the wastewater system.

Levine: But it does raise an interesting question for developing countries. We are fixed on this form of sewage handling. That is a tremendous investment in pipes and everything else. We have technologies for in-site disposable sewage, whether they are in space ships or more mundane locations. If those kinds of units were produced in the millions, we don't have any sense of what the real benefit and cost would be of going to a non-water transport system in towns and villages in developing countries.

Rogers: There are millions of septic tanks in the United States. Lots of countries have them. The problem is when you have high density use. I have lived in towns that had septic tanks on 16 housing units per acre and it is very unpleasant.

Levine: That is what I said. There are other technologies that aren't explored. We don't relate to them.

Sklar: There are positive environmental impacts of this kind of conservation measure. For example, in Cuemavaca, Mexico, where the water is treated, it was put into leaky pipes and then contaminated by surface sewage runoff. Relining the pipes has eliminated that contamination and in certain parts of the city provided substantial health benefits. It was not done as a health measure, it was done to conserve the water supply.

Moore: I want to summarize some of what has been said. Despite some plausible reservations about the gains to be made in conservation, whether it is wet water or not, we have heard several examples, including the one Sandra Postel went through, in terms of urban and industrial conservation. Monty Yudelman mentioned the CGIAR report that said, given existing technologies and existing lands, we could be increasing production to feed a 50 percent larger population. We have heard of the decoupling of growth and GNP with water demand. We've heard of some small-scale successes. There are many examples where serious wet-water gains can be made. If you combine

those advances at the beginning of the design phase for a project, and you say, okay if we do all of these, do we still need the mega-project? maybe the mega-project becomes a medium project. Pak Mun Dam in Thailand is one case where, based on people's concerns and comments, they were able to revise the design. It still may not be perfect from everyone's perspective. In the Western U.S., if we knew everything that we know now about cost recovery, subsidies, fisheries, and equity with Native Americans, we might not have given up the big dams completely, but we might have designed them differently and built in certain operational standards for reservoirs, certain pricing systems, and certain technologies both in the irrigation sector and the urban sector that would have ideally made the impact of those dams smaller. The point is that in countries where you are thinking of new capacity, let's bring all of this in at the beginning, so that we are not doing it 20 or 50 years after the fact, and let's give serious consideration to the alternatives that we have been talking about so that we can reap those real gains. We need to create political and institutional change so that some of these things that we have been talking about get adopted. Are there practical strategies that we can use to do that?

Rock: We started a dialogue. What is the next step? Where did we seem to agree? Where have we apparently agreed to disagree? Most importantly, where do we go from here?

Seckler: One of the linchpins in this field is how much water actually gets saved. There has been some disagreement around here on that. I would be happy if we agreed in the future to think in terms of wet water and the dry water savings, and it may be that the dry water is zero. We ought to get away from exclusively concentrating on the local efficiency and get to the basin level. Maybe I am wrong and maybe everybody else is wrong, but we can find out.

Rock: I would like to suggest that we get a bunch of these statements out and then step back from them and say, yes, that there is pretty much agreement there.

Blake: For example, there is strong agreement on the need for empirical data on the amount of irrigated land and its condition.

Sklar: The need for greater institutional accountability and transparency in the decision-making process.

Gleick: Attaching a higher value to water and somehow transmitting that to the parties involved-not just the farmers but the parties involved.

Levine: I think that there was general agreement that there should be more effort in coming up with a variety of options for a given intervention.

Blake: From an institutional point of view, there is broad agreement about the need for important qualitative and quantitative changes in the way the World Bank operates in this field.

Rock: Let me reiterate what we've got now. One is that we begin to think of water and water savings in terms of global rather than local systems and that we begin to think in terms of wet and dry water. Two, there is a clear need for much better data

about irrigated lands. Three, a need for greater interest in accountability and transparency among governments and donors. Four, we need to attach, and find a way institutionally to attach, a higher value to water. Five, whenever investment options are identified, we need to spend a little more time identifying more alternatives. Six, when it comes to outside institutional actors, we can't ignore the World Bank.

Svendsen: We seem fixated on the World Bank. For former bank staffers that is understandable. For the rest of us, I'm not sure why that is. There are lots of other actors in the game, from the regional development banks to, especially in the more developed countries, local policy institutions, policy research

institutions, and other kinds of research groups.

The focus on the World Bank implies that the only way to get the attention of policy makers is to twist their arms. I don't think that is entirely true. Policy makers are often themselves interested in change. They are anxious for ideas that can work. We don't always have to twist people's arms. That means that we can look for other avenues besides the World Bank to have influence.

Moore: It is not just a question of arm twisting, it is a question of providing incentives for policy makers as well as water users to change their habits. It is not only the World Bank, it is many in

stitutions. That brings up the need for a comprehensive effort to get new initiatives that are all going in the same general direction, rather than one policy over here that is contradictory and a different policy in another regional development bank, even in the same country and the same river valley.

Castro: I agree on the need for more participation of local people that are actually involved and have impact on projects.

Groenfeldt: Another point of agreement is that investments that increase water supply, like a new diversion, or investments that are supposed to enhance sufficiency, like a rehabilitation, need to be justified within the context of the entire watershed.

Warren: We have a tremendous amount of information that indicates that if you have participatory approaches without understanding the existing knowledge, decision making, and organizational structures, you might as well strike it off your rhetoric. This is not to say that we want to romanticize indigenous anything because there are obvious weaknesses and strengths in any system.

Levine: Agreeing with the objective, I don't know that that is the real problem. The problem is the institutional constraints against doing it. There is certainly a tremendous amount of rhetoric about water user participation in almost every country. I don't think a lack of data is what is inhibiting the effective use. There are other constraints that are operative.

"The focus on the World Bank implies that the only way to get the attention of policy makers is to twist their arms. I don't think that is entirely true. Policy makers are often themselves interested in change. They are anxious for ideas that can work."

Havener: In talking about getting to know more about irrigated agriculture on a global basis and on a specific basis, we need a good deal more differentiation in the socioeconomic circumstances in which irrigation occurs, but we also need to know much better the agroclimatic situation in which it occurs. There is a lot of comparative data for Bangladesh and Pakistan for instance - one being in a high rainfall area with deep clay soils and the other being a semi-arid desert with sandy soils. Directly comparing the functioning of those two systems is ridiculous. Yet, it goes on all the time. We need a much better specification of the agroclimatic setting in which we are judging the efficiency of irrigation investments and the effect of those investments or, for that matter, their sustainability.

Gray: Many developing countries would just as soon skip the agricultural phase and go directly to industrialization, if they could. It may be more important in the future than it is right now. They have an opportunity, which we have not had, to take advantage of a lot of these technologies. They can build them originally the right way instead of building them the wrong way and then having too much invested to redo them - like having a separate system for potable water and non-potable water.

Groenfeldt: We need a better index than irrigation efficiency for what we are talking about. I wonder about an analogy with the cropping index. We want something that can have a value greater than 1 to get at reuse. Maybe we want some number or some value that we can give for very wet water. Water that has been used many times should somehow be recognized with a simple term that we can talk about. For example, if water has been used so many times it becomes saline and then it goes through a desalinization plant and is used 10 more times, that seems to be a more thorough use of that water than in another case. Yet, we don't capture that with the irrigation efficiency index.

Rock: The water multiplier does capture the reuse.

Moore: But not environmental uses of water.

Rock: One thing that I thought you all would mention is, how large, if any, are the efficiency gains?

Moore: Wasn't that related to the first part of wet or dry water? There was agreement that the potential for water savings is important, but there is a disagreement about how much.

Yudelman: Would you define wet and dry?

Seckler: Let's say I'm a farmer and I'm using water on my farm at 50 percent irrigation efficiency. So 50 percent of it is leaving my farm into the groundwater or the surface water. Now, I buy a drip system. My efficiency goes up to 80 percent. Now, only 20 percent of the water is leaving my farm. Right? But the question is, what is the gain in efficiency globally? If that water that has left my farm is rushing off to the sea and doesn't do anybody any good whatsoever, then I have increased the global efficiency. But, let's say that somebody downstream of me has been using that 50 percent of the water that left my farm. Now, when I improve my efficiency, that person is getting less

water from the return flow. So that percentage that his amount of water decreases is dry water and there is no net gain to the system.

Moore: It is the difference between project efficiency and basin efficiency.

Gray: I don't think it is correct to say that it doesn't benefit anybody. There may be ecological values.

Seckler: No, I mean any value. I'm not distinguishing between farmers or birds or anybody. Whatever is of beneficial use.

Postel: If there are no gains from efficiency, that means that there is no value placed on in-stream uses.

Moore: I guess my definition is more that wet water gains are those recaptured gains from formerly lost consumptive uses. If you are gaining something that wasn't consumptively lost before but it showed up somewhere else, then that is not a true gain. That is what I would call dry water. The true reduction in overall consumptive use so that you have more water is a wet gain.

Seckler: You can have both kinds. If you are wasting water nobody is using, then recapture it: You get a wet water gain.

Gleick: It is a question of whether there is a zero sum or a non-zero sum.

Seckler: At the global level. Exactly.

Rock: I think the easiest way to think about it is a project versus basin.

Seckler: Yes. A little bit or the whole picture. That is the gist.

Levine: There is another element, does the route of travel make a difference? Certainly, in environmental terms it can make a difference.

Seckler: Absolutely.

Sklar: If the additional environmental benefits are energy savings or something else, does that make it wet, or is it still dry, but a little wetter than really dry? It seems a little slippery.

Seckler: We are not talking about its value so much as the quantitative flow in the system. Then, you can put on the values, too.

Levine: Sometimes you can get a worse situation. In the Nile, some of the water that presumably is available is being put on higher lands that are very sandy. The seepage from them is now causing drainage problems on the higher valued land down below. So by getting that extra use out of the water, they have actually made the environmental situation and the agricultural situation worse. Now they want to put in pumps for a drainage project on this waterlogged land instead of saying, we are not going to put irrigation water on those high lands.

Moore: I want to understand the relative emphasis that people place on the potential for gains through not building new projects versus the emphasis on, we've got to build

new projects, so that I can better understand how development dollars should be spent in the most efficient, effective, and environmentally sound way.

Postel: It seems that the disagreement is how much the analogy to the energy sector really applies to water. How much is to be gained through efficiency improvements? I argue that there is a lot to be gained through efficiency improvements.

Rock: The global efficiency argument says that there is very little to be gained.

Seckler: If it's a closed system - that's why it is important. If the efficiency argument is right, we certainly don't need to build much new capacity in the water field. We

"There are lots of rivers in the world that in the dry season are spewing out water that could be used to good purpose further upstream."

agree on the fact that we don't know quantitatively how much this is. We need to estimate that.

Moore: Where we split is how optimistic or pessimistic we are about the gains. We agreed that there are some gains. We don't know exactly how much they are and we don't know exactly what the benefits of the gains are, and some of us think that gains that you get may be more important for

environmental purposes because of the route of travel, and others think that the basin efficiency is going to stay the same and those parts don't matter so much.

Blake: It looks like this falls within the area of disagreement rather than the area of agreement.

Levine: The benefits from maintaining in-stream flows and so on - those values can be very high. That becomes again a very site-specific situation. If you are in the humid tropics and in what is a run-of-the-river situation, where you don't have much opportunity to store the water, it runs off to the sea. You get a low efficiency. But that doesn't mean anything. The fact that most traditional systems in Asia operate at 30 percent water efficiency doesn't have any significance because they couldn't do anything with that water in irrigation terms anyway. So it has no value. In the dry season, you rarely get efficiencies of that order. They are frequently much, much higher. Many of the average water efficiencies on irrigation systems that you hear about are misleading. You have to think about the site from which each one of those sets of data come.

Rock: This suggests the peak load problem in power plants, where in the flood season you get a lot of low efficiencies because you don't need it, and in the dry season, high efficiencies because you have to use every damned drop.

Gray: Where you have to look at it globally is where there is a net gain. If you look at the total amount of fresh water in the world, everybody agrees there is plenty. It is the maldistribution - not having the right quantity where you want it, when you want it. That gets back to the local versus the larger approach.

Seckler: I just meant globally in a river-basin sense, not the whole world.

Groenfeldt: The way to conceptualize where there is potential and where there isn't is to imagine ourselves at the river mouth during the dry season. If there is more water

flowing down than we need to sustain the river ecosystem and to keep saltwater intrusion out, there is potential for development upstream. Then we have to ask, is there any demand for it upstream? I think we have been led astray by this Nile example. There are lots of rivers in the world that in the dry season are spewing out water that could be used to good purpose further upstream. We can't deny that there is still much potential for further irrigation development. What we are saying is that we can't assume that there is potential for further irrigation development. We have to ask the question.

Rock: That is part of where we disagree, I think. What else?

Moore: Also there is the question of timing. Some of us believe that even if the efficiency gains aren't as big as we hoped, that if you implement them you have the ability to change the kinds of new supply projects that you may need because they will reduce overall demand in the longer term.

Yudelman: In other words, if you have demand management now, you can reduce the supply later on?

Moore: Even if the gain isn't as big as you thought it would be, you might have had to delay your large capital investment for 10 or 15 years and have had the opportunity to invest the capital in something else. That is what I mean by the timing.

Blake: I think we all agree that is important to know. Second, we agree that that has to be determined empirically on at least a watershed basis.

Levine: There is some support for that idea-even in the way many projects are developed. The larger ones, particularly, are developed in stages. You always have excess water during the early part of the project - the first 5 years or whatever. If you don't restrict the flow at that time, if you give plenty of water to those first users, in a short time it becomes a right. Then it becomes difficult to accommodate the rest of the project.

When IRRI was founded, they put in a lot of pumps and they weren't very efficient in the way they used the water for producing rice. So the water in the drain went into a small creek that went down into one of the villages. About 2 years later, they had a major power failure and the pumps were off for 3 or 4 days. A delegation of farmers came up and complained that IRRI was stealing their water because they had gotten to the point where that excess drainage from the IRRI farms was considered their supply. So it is very easy to establish a perceived right to the water.

Looking ahead in terms of the way systems are implemented or in terms of the urban areas anticipating demand is a good practice generally.

Peabody: It's never done.

Levine: No, even though they know it. In the ones we have worked with, we have said, this is going to happen. You are going to have trouble with your water users. That's extra management.

Rock: What else do we want to put on this list? I heard disagreement around the economics of big dams.

Seckler: At least in some of the more densely populated areas, probably India and China, we are going to need big dams. I think most people don't agree with that. As a subset of that, there is probably some disagreement over whether small dams can replace the big ones. That is an important issue that we would probably disagree about.

Levine: In the Soil Conservation Service small watershed program, there was a big dam, small dam controversy. The arguments against large dams were based on the flooding of lowland valleys and the loss of prime land. The counter-argument said that the upland dams, the so-called small dams, flooded valleys, too, some of which were almost as valuable in terms of agricultural production as the larger valley lands. There was no general consensus on the basis of those 50 pilot watersheds that the upstream had any less environmental damage than the downstream. On the other hand, they solved different problems. They agreed that in some sense that the downstream flood protection measures were necessary and the benefits from the upstream were about equal to the downstream anyway. So they did both.

Moore: The fact that many small dams inundate more area than one big dam is not, I think, the only consideration.

Levine: It isn't obvious when you commence.

Rock: I have now four areas of disagreement. One is lack of clarity about how large the system-wide efficiency gains are in a given watershed or ecosystem. Two, there is clear disagreement about whether big dams are needed and about whether small dams can replace big dams. Deborah Moore's timing issue is a corollary of those, too. If you need big dams, then this timing issue of doing demand management probably doesn't make much sense, and there is an area of disagreement there that you can demand manage so you wouldn't need the big dam in the short run and hopefully that would slow the growth of demand and, at least as I understood it, that would help forego the need for big dams in the long run.

Moore: No. It would forego the need for large dams in the short term and maybe turn a large dam into a medium dam.

Sklar: Not just small versus large dams. It could also be irrigation projects and so forth.

Levine: I don't know if there is any disagreement with that. At least not on my part.

Moore: Which?

Levine: The idea that in some way looking at the demand side won't delay and therefore leave options open for the future. That's what you are saying. You are leaving the options open rather than committing yourself early.

Seckler: You've got to remember a big dam has a 25-year horizon, so that if these projections of food demands for 2030 are valid, we are going to be there about the time a dam commissioned today would be ready to start meeting those demands.

Moore: Sometimes a large dam will take away the opportunity of doing some of the other small things. If you do some of the small things now, that may mean that your demand projections for large systems were not right.

Rock: In one statement David Seckler says that we are going to need big dams in India and China, then your timing issue goes by the wayside. He is saying it is not a timing issue. You are going to have to do it now or you are going to have to do it later.

Seckler: Even if you do it now, it is going to take about that long to get them on stream. That is why I feel a little bit urgent about it.

Postel: In the energy sector, we have overcapacity now because we didn't understand the potential for demand reduction. So we built all these big supply capacity systems in energy, which now we don't need. That is a flag to me to say, let's look at what we can do with demand management before we make these huge investments in water supply.

Rock: Whether or not the power model is a good analogy is another area of disagreement.

Levine: There is another aspect. You have two opportunities to increase supply in agriculture. One is the supply of irrigated land. The other is the actual yield per unit of water. With energy you don't have that option very much because the efficiencies were already so high in power production. You do have a little more flexibility if you have faith in plant breeders and you can feel a little more comfortable about delaying the investment.

Postel: That is an area where we do need to know more, because irrigation expansion now is at half the rate it was in the 1950s and 1960s and per capita irrigated area has been declining for 14 years now. We are in a different framework than we were when a lot of these large projects got going before. What are we doing about that? How does that change our framework for meeting food needs with regard to investments and irrigation expansion versus irrigation productivity versus rainfed?

Levine: We ought to be worried. There's no question about it.

Havener: You have a fundamental and serious disagreement. On one hand, many people believe, we have had and are going to have food coming out of our ears and on the other hand the next three people say people are going to be starving.

Blake: Food coming out of their ears from where? The United States and Europe?

Yudelman: Coming from Eastern Europe certainly.

Blake: But how are people from developing countries going to pay for it? You've got to think about it.

Yudelman: Yes, but we are talking in an economic context. Of course, I think about it. As somebody over here said, I don't want to be responsible for a billion people starving. What are you telling me? That you want to increase to satisfy everybody's basic needs by expanding irrigation?

Blake: I'm saying that if you have all this food in the United States and Eastern Europe and there is a deficit in the developing countries, their people have got to buy it. What are they going to use in order to pay for it?

Meinzen-Dick: What I was going to say as a point of disagreement before this came up is: Is the transfer of water from the agricultural sector to "higher" value uses a good thing? I think that is a point of disagreement.

Yudelman: How can we agree on pricing?

Moore: Today was basically worthless. We don't agree. We're going back to the fundamental things that we talked about this morning, which I thought we had made progress on.

Rock: That's not true at all.

Seckler: We have parallel agreements and disagreements.

Moore: David Groenfeldt said you can stand at the mouth of the river and in many cases say that there are large increases in water use that could happen upstream. I am wondering how much agreement there is on the need to protect water-dependent ecosystems.

Levine: The river that David is standing at the end of is typically in humid areas where the water doesn't have a great deal of value anyway. I would like to hear some examples of large rivers flowing through arid regions where this is the case during the dry season. Take the big ones - the Ganges, the Nile, the Colorado - you don't have much water coming out the end. It is only in the humid regions where we don't need it so much for agriculture.

Groenfeldt: If you are willing to entertain big dams, then you would want to stand at the mouth of the river throughout the year and see if there is any water coming out and how much. Then you would calculate how much you need for whatever value you placed on the riverine environment. As was brought out, big dams will store water over a period of years. So you don't have to worry about dry seasons.

Seckler: One of the reasons I tilt toward big dams is because of long-term storage capacity. You can pick up your flood-season flow and use it for flow augmentation in the dry season. It might be feasible to go up to headwaters of the Niger and put in large storage dams as ecologically safely as you can and regulate the dry-season flow. That would capture the flood during the wet season, which also creates havoc along the Niger. So you can stabilize that and protect wetlands habitats by augmenting dry-season flows.

Moore: But weren't the wetlands doing okay with the natural hydrology?

Seckler: That's right, but the dry-season flows are getting lower and lower. Therefore, the wetlands are getting hit in the dry season.

Parcells: There is a mixed record on that. Water timing is very important to aquatic ecosystems. In the Everglades, 90 percent of the life forms are absolutely gone because of lack of flows, largely because they are diverted to the oceans.

Rock: It sounds like there is an agreement on protecting ecosystems, but a disagreement around means.

Rogers: On the issue of protecting the in-stream flows and wetlands, it depends on what it costs and what the benefits are. Dale Whittington did some calculations that showed that it would be much better for the Europeans to pay the Egyptians not to build the Jonglei Canal because it is in an important flyway for the European bird populations. For a small amount of money, relative to the cost of building that canal - it's in the low hundred million dollars for total cost and maintaining the thing - Europe could pay Egypt not to grow cotton or wheat or whatever they are going to do with the extra water. It is a much more efficient use of the money to do that and solves the environmental problem very nicely.

"Irrigation expansion now is at half the rate it was in the 1950s and 1960s and per capita irrigated area has been declining for 14 years now."

Svendsen: Water rights can be transferred to allow that kind of bookkeeping and that kind of payment to take place.

Sklar: That is an important thing to bring up, going back to where do we agree. Two out of the three groups brought up property rights and equitable and accountable systems.

Levine: That is a difficult area. I don't disagree with you, but New York City, for example, purchased the riparian rights for water in the 1800s all the way up to its source. So its water is not filtered - it is some of the best water in the world. At present, however, EPA has a regulation that says that the water will have to be filtered because of disease potential, or New York City has to have a plan that restricts development in the watershed area. For New York it is a \$2 billion investment in filters and an operating cost of \$200 or \$300 million dollars a year. So their approach is to restrict development in the watershed. There are many people living in the watershed who don't want any restrictions. One could argue that if those people are willing to pay the \$200 million a year operating costs, it will be okay for New York. That is not considered. They don't want to do it. I'm not sure how willing the developed countries are to pay for protecting the environment, and I am not sure whether Europe will be willing to pay on an on-going basis the value of that water as Egypt perceives the value.

Svendsen: We had that with the buyback of debt at a discount in various countries. There is no reason that you couldn't translate that concept into water.

Rock: Let's turn to the last issue, which is, where do we go from here? You were all invited as a way of beginning a dialogue between developmentalists and environmentalists. It's not the right distinction, but it is a distinction. We talked about how we defined the problem, what we saw as the priorities, what strategies we thought made

sense, and where we think we agree and where we disagree. Ultimately, the fundamental question is not only, (a) was this a useful dialogue? but, (b) do we want to keep the dialogue going and, if so, how?

Blake: We must keep up the dialogue among the concerned parties and we must generate better information to make that dialogue more decisive.

Rock: I sat here and most of the time I couldn't figure out whether the disagreements were over facts or whether they were over values. To the degree to which they are over facts and the facts are unknown but knowable, it seems to me that one useful thing to do is to engage in some research done jointly by advocacy organizations and research organizations, so that there is joint ownership in the outcome. Some shared understanding can come from that.

Seckler: What you have just said is the most pleasant outcome of our meeting. As far as I can detect, there isn't any disagreement at all about values. There is more commonality of values and weights on values in this group than I would have thought. We all agree that we need to feed people. We may not know how much that means. We have to protect these wetlands. We have to do all of this. We have found that virtually all the disagreements we have are empirical in nature. I have one hypothesis and somebody else has some hypothesis. The interesting thing is that those are empirical hypotheses. They are things you can get data on. It is a situation that leads to research that can actually do some good. You are not going to do more research just to be doing it. More research can resolve some of these big problems by getting some quantitative estimates on the things we have been discussing. I think that is great.

What do we do in the future? I don't know if we have to decide that, but one of the ideas that we have kicked around was that perhaps after this meeting and after giving ourselves time to think more deeply about the issues and trying to find some facts, if we can, we could come back on this subject at a later date.

Groenfeldt: I support creating and constituting ourselves into some kind of working group, not just doing a little study over the next 6 months on our own, but something more formal than that. It would be valuable at the present time when World Bank water policy and water seems to be very much in the air. The bank is also talking about a regional irrigation strategy. I think one of the reasons that we agree so much on values is that we don't have the facts to identify where our values diverge. I think if we did a little research, we would come back in 6 months and have more to argue about on more of a value basis. This group is the right mix to do participatory research that would carry some weight because of who does it.

Moore: My interest is in building a broader, stronger, more effective, and forceful constituency for various policy and institutional changes. That's what an advocacy group does. We have agreed that institutional changes are desirable in many areas and that that has to do with politics and many other things. My interest in having more personal contact with the research community is to be able to use the research in the advocacy process. It is not only a matter of doing collaborative research. I think the people that do research are good at doing that. Maybe the advocates aren't so good at it. Or,

maybe they are, but they don't want to do it. I'm not sure that we should all change what we do. Again, my interest is in developing some idea of the areas where we agree so that we can support each other in those areas. My interest is in having formal or informal conversations with all of you over a longer period of time to see whether there are ways that we can support each other in our work.

Levine: There was a precedent to this sort of group and that was the ADC Research and Training Network, which provided a vehicle for getting those interested in particular problem areas together on a regular basis so that you started talking the same language and crossing disciplines, and so on. You started to understand where others were coming from and how to speak to each other and the understanding increased very substantially. Those were very useful activities. That is a model that suggests coming together occasionally will work. We probably have to define the areas for discussion a little more sharply than we have at the present. For example, one where I think there is agreement is this question of how decisions are made with respect to activity. Even if we don't agree on what those answers will be, I think we all have to agree that the present system of making decisions about water projects is not appropriate either from the researchers standpoint or certainly from the advocacy standpoint. You could have a meeting that focused on that kind of issue, where everyone did a little homework about their perception of the present process, what changes would be desirable, and then how those changes could be encouraged. We could do our homework and come back 3 months later and have a discussion that centered on 1 or 2 of those issues rather than all 6 or 8 or 10.

Rogers: I like the idea of giving homework. David Seckler's point is that we agreed to articulate our disagreements. I think that the homework ought to be some written documents and to actually pick the issues - irrigation efficiency and things like that. We could do a little research paper with a couple of people getting together or have two different groups write something on big projects versus small projects. There is literature on that. There are data. There are conceptual models. Then you would start to discover where you don't understand, or whether the disagreement is there. That's nice homework. We can grade it.

Svendsen: I was surprised to find out how many lobbying groups or interest groups have some interest or activity in the international arena. It says that people who do research can't afford to ignore, or even practitioners can't afford to ignore, this group of people, but also how similar many perspectives are. I agree with the point about the separation of interest and comparative advantage. It is a mistake to try to merge the interests of these two groups too closely. Researchers are supposed to be skeptical. We are supposed to ask questions. You would be rotten lobbyists if you stopped all the time and said, gee, is this really what I want to say and is this really true? You wouldn't do a good job that way.

Moore: Maybe a twist on that is if someone is doing a particular piece of research that they feel may be valuable for political reasons or for institutional change, now that they know who we are, they can send it to us. And if we have a particular project coming up where there has been opposition or debate over technical or economic issues,

now that we know who you are, we can call you up and say, what's your expert opinion?

Havener: I have found the discussion stimulating. Anyone interested in global food security and long-term economic development has to be concerned about these same sets of issues. I am delighted that we were able to play a modest role along with Deborah Moore in bringing this group together and getting the dialogue started. It is clearly one that is worth continuing if we can figure out ways to make it rewarding to you and effective to the outside audiences that we have been talking about.

One of the things that crossed my mind is whether or not we have all of the important actors here, either from the advocacy standpoint or from the researcher standpoint. It seems to me that water law, and knowledge about water law, is one area that is missing in our dialogue today. Such lawyers might bring a peculiar set of skills to the discussions, and they often force us to think more clearly and enunciate our positions more specifically. That is useful especially as it relates to a subject like water.

Gil Levine mentioned the *ADC* Research and Training Network - an important and interesting experience of Winrock International in an earlier incarnation - and it did lead to important conclusions and important research papers that sensitized many policy advisors, if not policy makers, on important issues.

The advocacy community, it seems to me, can learn from Ambassador Blake and some of the things that he has been doing. I would argue that Ambassador Blake is one of the most effective people on the Washington scene today in talking about trade-offs on agriculture development and environment issues. He has achieved this status by putting together one of the most informal networks I have ever seen. At the organizing meeting, which was held some time back, people like yourself sat around the table and discussed these issues. They decided to form an advocacy group. It is an informal coalition of people that are concerned about similar issues. Ambassador Blake is able to speak and write on behalf of a coalition of people that share common concerns. To date there are no membership fees. There is no statement of common purpose that we are required to sign. Bob sends out papers and says, if you disagree with this, let me know. If you agree with it, let others know. He has become very effective in that process. Both in the *ADC* Research and Training Network and the Committee on Agriculture Sustainability experience, there was at least one key person that had both time and interest to perform a leadership function and to help coordinate the effort. So while we can talk about getting together on an informal basis and defining research projects and identifying funds to support them, you do need to think about leadership and sustainability over time. Otherwise, this will likely be just another unsustainable group.

Rock: Let's close by thanking all of you for coming. I have rarely sat in a day-long workshop where there has been as much sustained enthusiasm. That was quite nice to see. Second, thank you to our hosts Winrock and EDF. Third and finally, it seems to me that you all have provided a basis for an ongoing dialogue.