The Political Economy of International Environmental Cooperation

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THE POLITICAL ECONOMY OF INTERNATIONAL ENVIRONMENTAL COOPERATION

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THE POLITICAL ECONOMY OF INTERNATIONAL ENVIRONMENTAL COOPERATION

INTRODUCTION

Alan Richards

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Few now doubt that successfully managing environmental challenges will be central to public policy in the coming century. Unless the international community can cope with transnational problems such as global warming, destruction of species and tropical rain-forests, depletion of oceanic fish stocks, and increasing water scarcity in arid regions, both domestic and international conflicts may easily arise. To take only one example, for over a decade analysts of Middle Eastern affairs have hinted darkly at the possibility of "water wars" breaking out in that (still) politically volatile region. Books, working papers, and articles on environmental issues as national security problems are proliferating rapidly. The problems of international environmental political economy pose increasingly pressing issues for analysts, policy makers, and citizens.

Such concerns helped to motivate the project, "The Political Economy of International Environmental Cooperation," sponsored by the Institute on Global Cooperation and Conflict and generously funded by the John D. and Catherine T. MacArthur foundation. The project supported University of California graduate students writing their Ph.D. dissertations on issues of international environmental cooperation. On concluding their dissertation research, the doctoral candidates presented policy papers at a workshop held in Santa Cruz, California. The student-organized workshop brought together these promising young scholars and policy analysts with various senior members of both the academic and international policy community. Those who remember their own graduate student days can perhaps appreciate the courage and self-confidence of young scholars who designed a workshop in which their own work would be presented to a forum of some of the field's most respected senior analysts. Their papers are collected here in this volume.

A key intellectual theme of the project was the (always difficult, always necessary) marriage of theory and policy. However varied the details of international environmental political economy may be, the core problem is always the same: how to induce self-interested, often myopic, decision makers to "do the right thing," or to behave in ways that minimize environmental damage and/or optimize the utilization of natural resources in the presence of external constraints. Addressing such problems is difficult enough

within a polity; forging the transnational cooperation needed to cope with environmental issues confronts still greater obstacles.

Or does it? Theorizing about international environmental cooperation seems caught between (older) misleading simplicity and (more recent) inconclusive and bewildering complexity. Older theories with origins in the tradition of neo-classical economics stressed such simple concepts as "the tragedy of the commons," "the capture by vested interests of regulating public bodies," and "one-shot prisoners' dilemma games." Political scientists analyzing these issues divided here, as in other applied areas, into "realists" and "liberals" in their views of if, when, and how international cooperation might occur. Both literatures often seemed counsels of despair, implying that cooperation was impossible unless actors were altruistic.

Curmudgeons noted, however, that nations often did cooperate. During the past decade or so, theory has begun to catch up with reality. Game theorists such as Axelrod (1984) and Kreps et. al (1982) showed how cooperation might occur in repeated prisoners' dilemma games; international relations theorists such as Stein (1990) offered syntheses of liberal and realist views; while inter-generational models of resource allocation became increasingly sophisticated, allowing for greater complexity, realism, and diversity of outcomes. The possibilities of international cooperation now seem well-grounded in theory.

But in some respects theory offers us a poisoned chalice. For example, game theory offers such a rich menu of possible outcomes ("too many equilibria with no way to choose," as Kreps [1990] puts it) that the analyst can often, at best, use the theory as a way to systematize his empirical data, or to tell her story using a certain (game theory) language. We are still far from any straight-forward methodology of translating theory into concrete policy recommendations.

Perhaps this is inevitable, and unsurprising. After all, interactions of multiple actors, with complex, shifting goals in a world of uncertainty and asymmetric information, are inherently complex, path-determined, and situation-specific. Historians have long thought so; social scientists increasingly find that their own theories back them up. Theory helps, but the search for the philosopher's stone that unlocks all problems is likely a doomed, even quixotic, exercise. Indeed, those rules of thumb to which policy makers have long had recourse, have now become theoretically respectable.

We are left, then, with using the insights of modern theory and then trying to steep ourselves in all of the rich detail of a given problem of cooperation. Most of the papers in this volume are in this tradition (although Bobenrieth's is the least so, being primarily an attempt to extend the theory of optimal exploitation of forests in a direction which may yield policy-relevant conclusions). Here, as so often in policy analysis, we are often looking for "win-win" situations.

In particular, analysts and policy makers often seek to find ways to expand the decision space, or, to shift the metaphor, to determine the currency of acceptable side-payments. Actors X and Y may be deadlocked on a particular question (e.g., the division of water in a river basin). However, their relationship, particularly if they are nation-states, is inherently multi-dimensional. It is conceivable that other aspects of X's relationship to Y may induce X to agree with Y on water, if X is suitably compensated (for example, in the national security arena). Only a detailed examination of a particular case can tell us much about the likelihood of striking such "win-win" bargains.

The papers in this volume offer an Aristotelian line-up of earth, fire, air, and water issues. The problems of optimal depletion of forests (Bobenrieth), managing global emissions and related global warming problems (Rich), water negotiations in two different regional settings (Carlisle and Williams), and issues of oceanic fisheries (Potter) all receive close, detailed attention. The volume concludes with an evaluation of their work from the perspective of a World Bank professional on the policy-making process. The result shows how the interaction of theory and empirical material can generate results helpful to policy makers. We hope that such close work between theoretically grounded, empirically rich policy analysts and professional decision-makers will become increasingly frequent in the years ahead. The University of California Institute on Global Conflict and Cooperation is committed to promoting such interactions.

REFERENCES

Axelrod, Robert. 1984. *The Evolution of Cooperation.* New York: Basic Books.

Kreps, David M., P. Milgrom, J. Roberts, and R. Wilson. 1982. Rational cooperation in the finitely repeated prisoner's dilemma. *Journal of Economic Theory* 27: 245–52.

Kreps, David M. 1990. *Game Theory and Economic Modeling: Clarendon Lectures in Economics*. Cambridge: Cambridge University Press.

Stein, Arthur A. 1990. *Why Nations Cooperate: Circumstance and Choice in International Relations.* Ithaca, NY: Cornell University Press.

NORTHEAST ASIA REGIONAL COOPERATION:

PROPOSALS FOR CHINA–JAPAN JOINT IMPLEMENTATION OF CARBON EMISSIONS REDUCTION

Changhua Sun Rich

China and Japan rank as the world's third and fourth largest carbon emitters. According to a recent study, China's coal-burning power plants have caused acid rain affecting Japan. There are political and economic incentives for the two countries to cooperate in the reduction of carbon emissions and sulfur dioxide emissions: improvement in the energy efficiency of old and new small coal-fired power plants in China is a potential area for joint implementation projects.

I suggest three forms of joint implementation: capital investment in revamping the old power plants, establishing energy service companies to improve efficiency and to reduce pollution of new small coal-fired power plants in rural counties in China, and sponsoring a pilot project for adding CO_2 emissions permits to the existing SO_2 emissions permit system in a northeast city in China. The CO_2 and SO_2 emissions reduction can be bundled together by instituting a domestic SO_2/CO_2 emissions permit system in China and implementing it as a coal-conservation mechanism.

Related to this, I investigate local, national, and Northeast Asia regional emissions permits trading markets, and report the results of laboratory experiments, conducted both in China and in the United States, on two emissions permit marketing trading rules.

Introduction to Joint Implementation

An intrinsic part of trade and capital market integration in Northeast Asia must include addressing the problem of regional and global environmental degradation. Regionally, China's coal-burning plants have caused acid rain affecting not only China but also Japan and Korea. Globally, China is the developing world's largest greenhouse gases emitter, the third largest in the world, and Japan ranks as the world's fourth largest carbon emitter. A vital question is how these two neighboring countries can collaborate in the man and increasing domestic decentralization in China.

Both China and Japan are signatory parties to the UN Framework Convention on Climate Change (FCCC). However, industrial countries and developing countries have serious conflicts in how to limit carbon emissions. China, representing the typical argument by developing countries, believes that industrial countries are mainly responsible for the existing carbon emissions buildup. China argues that industrial countries should reduce their carbon emissions and transfer financial resources and technology to developing countries for global environmental protection. Industrial countries argue that the

cutback of carbon emissions by industrialized countries would soon be overwhelmed by agement of regional and global environmental protection, given sovereignty constraints the increasing emissions of developing countries. If China and other developing countries double their emissions, the industrialized countries will have to reduce their emissions by 70 percent in order to achieve a worldwide reduction of 20 percent of the 1990 level (Manne and Richels 1990).

If we take a look at the arguments of the both industrial and developing countries, we can see that both sides want carbon emissions reduction in the atmosphere. Each, however, wants the other to do it. Still, there is room for consensus. The idea of joint implementation offers something for both sides. Developing countries need financing and technology for their environmental protection; industrial countries want to reduce the cost of carbon emissions reduction and they want the developing countries' commitment to carbon emissions reduction. To address these concerns, Norway proposed the idea of Joint Implementation (JI).

The term joint implementation (JI) is not defined anywhere in the Framework Convention on Climate Change. As a concept, it was introduced into the intergovernmental negotiations in 1991 by Norway, and it is alluded to in Article 4.2. of the FCCC as a mechanism for cooperation between countries in meeting the objective of the greenhouse gases reduction. The Global Environment Facility (GEF) and Norway co-financed two joint implementation demonstration projects in 1993. A joint implementation project is one where an industrialized country or countries provide technology and financial assistance to implement a carbon emissions reduction project in an East European country or a developing country and then seek credit under the UN Framework Convention on Climate Change. Under the FCCC, developed countries have the obligations to reduce their greenhouse gases emissions to 1990 level by the year 2000. Developing countries are allowed to continue to increase their greenhouse gases emissions.

For countries like Japan and the United States, JI, when compared with a carbon tax, is relatively shielded from domestic politics. This makes JI politically feasible for them. In addition, cost effectiveness is a major attraction of JI for the industrial countries.

Potential benefits of JI to the developing countries include: reduction in the carbon emissions by the developing countries without compromising development objectives; increased awareness of the climate change problem in developing countries due to learning and dissemination processes generated from the JI project; transfer of clean technology could shift the developing countries to a development growth path with lower greenhouse gases emissions.

JI has been a highly controversial idea. The main criticism is that JI diverts world attention from developed countries' obligation to developing countries rising carbon emissions. After heated debate over the joint implementation issue, international climate change negotiations had a breakthrough at the 1995 Berlin Conference: the Conference of the Parties to the United Nations Framework Convention on Climate Change at its first session in Berlin decided to establish a pilot phase for "Activities Implemented Jointly (AIJ)." AIJ is similar to JI except that there are no credits accumulated under AIJ. In summary, JI can be one step towards implementing the FCCC. It does not and should not substitute the efforts of reducing greenhouse gases domestically by the industrial countries.

Political and Economic Incentives for Participating in Joint Implementation

Introduction to Current Programs

Since the Berlin Conference, there have been rapid developments in AIJ around the world. The Netherlands and Germany initiated pilot AIJ projects in Bhutan, Hungary and Russia. In June 1995, the "Statement of Intent for Sustainable Development Cooperation and Joint Implementation of Measures to reduce Emissions of Greenhouse Gases" was signed by the United States and Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama. In December 1995, eight projects were selected by the United States and the host countries as AIJ projects. These projects were voluntary, private sector-financed projects employing geothermal, biomass, hydroelectric and wind energy technologies and forest management practices in Costa Rica, Honduras, Nicaragua and Russia.[1]

[1]This information can be retrieved on the Internet at http://www.ji.org/usiji.htm.

In November 1995, the government of Japan officially decided to launch the "AIJ Japan Program." The "Inter-Ministerial Agency Coordination Committee for AIJ" meeting was held in January 1996. The Ministry of International Trade and Industry (MITI) and the Environmental Agency (EA) are co-chairs of the committee. So far, Japan and the host countries have approved eleven AIJ projects, ten of which in Asia and one in Africa. China is the host country for two AIJ Japan Program: the Japanese government funded a clean coal technology transfer to Chinese iron industry, and a small coal-fired boilers efficiency improvement project was jointly funded by Kitakyushu city, Japan and Dalian City, China (See footnote 1).

Mr. Qu Geping, chair of the Environmental Protection Committee of the Chinese Peoples Congress, made a statement before the Berlin Conference in February 1995 saying that China, under certain conditions, would consider participating in JI as a form of assistance to developed countries for fulfillment of their obligations under the FCCC (Qu 1995).

Since the first session of the UN Intergovernmental Negotiating Committee on Climate Change met in 1991, international negotiations have been long and strenuous. Why do governments give such quick and warm response to the AIJ agreement? What are the forces behind this rapid development of AIJ? What are the incentives and implications of AIJ projects for Japan and China? Japan and China each embrace the idea of joint implementation for different reasons. The following section explains the actors, the payoffs and the focal points for consensus in the AIJ negotiation between China and Japan in a two-level game framework.

Incentives for Japan

The negotiations over an international climate regime take place at both the national and international levels. At the international level, the players are the nation states, intergovernmental organizations, business nongovernmental organizations (NGOs) and the environmentalist NGOs (Young 1995). Japan and China are on different sides of North–South debates. Japan is being criticized by developing countries and international environmental groups for not making specific commitments to its carbon emissions reduction. In 1998, the Third Conference of Parties of the FCCC will be held in Tokyo. Japan is under international pressure to demonstrate its willingness to take concrete steps towards the prevention of climate change. Regionally, the Japanese government has the ambition to play a leadership role in Northeast Asian affairs. This means that Japan will be likely to participate in Joint Implementation which provides a good political gesture to the international community and it serves to enhance its leadership position in Northeast Asia.

At the national level, there are three types of actors in Japan: the Ministry of International Trade and Industry (MITI), the Environment Agency (EA) and the grassroots environmentalist nongovernmental organizations (NGOs). MITI which represents industry and business interests is the most powerful actor of the three. Japanese international environmental policy-making is, at least in part, the result of an interaction between domestic interest groups. In first half of the 1990s, Japan's economy experienced a prolonged recession, making business leaders more interested in economic gain than environmental issues. On the other hand, the influence of the grassroots NGOs on local governments and national politics has been growing. Polls in Japan show that an increasing number of people prefer environmental protection to economic growth (Imura 1993). There also have been growing local initiatives in activities helping Chinese cities to control acid rain and carbon emissions. The EA is not as powerful as MITI, but the EA has support from the NGOs. The EA's activities effectively limit the power of the ministries, including MITI. Still, the EA and MITI often work together to implement environmental policies once a consensus is reached (Barrett and Therivel 1992).

In the case of the AIJ Japan Program, MITI and the EA are able to forge a consensus because AIJ/JI provides a linkage between political/economic interests and environmental concerns. The Japanese industries see there is a market niche for environmental protection technology and products. Since the oil crisis in the 1970s, Japanese energy and environmental policy have both promoted research and development in new coal technology designed to reduce air pollutants as well as improving energy efficiency. Foreseeing the rapid increase in the demand for coal-fired power plants in the Asia–Pacific region, the Japanese government formed the Japanese Committee for Pacific Coal Flow in 1987. Membership includes more than eighty private companies and corporations (including banks, manufacturers of heavy industrial equipment, electric utilities, trading houses, technology manufacturers, and mining consult-

ing firms). The government and the private enterprises have been actively positioning Japanese industry for future markets. They anticipate an increasing demand for clean coal technology, created by international concern for climate change and environmental regulations (Parker 1992). In light of this, MITI may perceive AIJ with China as economically beneficial. Consequently, the EA, the NGOs and MITI can reach agreement on a AIJ program.

In short, AIJ/JI is politically feasible both domestically and internationally for Japan. It may also produce economic benefits for Japanese industries.

Incentives for China

The Chinese government also faces international pressure to control its carbon emissions. Pressures come from both the developed countries such as the United States, Canada and Australia and the Alliance of Small Island States which are likely to be hardest hit by rising sea levels resulting from global warming. The Chinese leadership recognizes that China would attract more criticism about its coal burning in international negotiation in the near future. China is the world's third largest emitter of carbon dioxide and fourth largest greenhouse gases emitter. They are also aware of the serious threat of global warming. The Chinese EPA, UNDP and the World Bank issued a report in 1995 saying that by 2050, rising sea levels could inundate forty-eight cities and counties in coastal areas of China including Guangdong and Shanghai (NGO 1995). Similar to the inputs in the Japanese decision making process, interactions/bargaining among the developed and developing country blocs, intergovernmental organizations, environmental groups all affect the Chinese decision making related to climate change.

It is difficult for policymakers in China to forgo the benefits of industrialization in order to save the environment. Yet, China signed the Montreal Protocol to phase out the production of CFC when it was given technology and financial transfers around sixty million dollars for the adoption of CFC substitutes. The experience of the Montreal Protocol offers an insight in the Chinese international environmental policymaking. The side payment played a key role in making the protocol acceptable to the Chinese. This is not an issue of a "bribe," a phrase often used in the literature which trivializes and demeans the issue. Instead, the side payment represents the recognition/concession by the developed countries to the equity concerns raised by the developing countries. The side payment also serves to link the environment to economic development.

At the national level, the international environmental policy making is a result of the interactions among the branches of the Chinese government. The Chinese climate change negotiation team consists of members from four ministry-level organizations: the State Bureau of Environmental Protection (also referred to as National Environmental Protection Agency [NEPA] in English literature), the Ministry of Electricity, the Ministry of Foreign Affairs, the State Atmospheric Bureau, and the State Science and Technology Commission (SSTC). SSTC is the leading agency in charge of coordinating the ministries. Each of these government agencies represents different sets of concerns. NEPA has as its priorities domestic water and air pollution problems; the Ministry of Electricity is interested in attracting foreign investment in the energy sector; the Ministry of Foreign Affairs wants to make sure that China's position on international climate change negotiations is consistent with other Chinese foreign policies; the State Atmospheric Bureau accesses the impact of climate change.

Interactive decision making at the national level is a complex process. With rapid economic growth, China feels its growing economic strength and status in the world economy. Politically, it demands respect and recognition from the international community. Chinese leadership is specially sensitive to foreign interference with China's internal affairs using the environment as an excuse (Jiang 1996). Domestically, the uncertain nature of climate change makes the issue of the global environment pale when compared with the urgent domestic environmental and developmental needs. In the case of Joint Implementation, NEPA and the Ministry of Electricity both support China's participation of JI, because the technology transfer from JI would benefit the domestic environment and energy sector development. On the other hand, the Ministry of Foreign Affairs argues against China's participation in JI. It held that China should support other developing countries who believe JI is a scheme used by developed countries to evade responsibilities and to transfer the burden of carbon emissions reduction to the developing countries. Nevertheless, Chinese policymakers of different branches of the government were able to identify a focal point where the different interests intersect: the additional financial assistance and tech-

nology transfer from JI. Again, AIJ/JI is a step, not the ideal or final solution, towards building a linkage between the environment and development.

In conclusion, AIJ provides the linkage between global environmental concerns and domestic economic development. It offers political and economic incentives to different interest groups to both developed and developing countries at the international and national levels. This explains the fast embrace of the AIJ we observe around the world. Because AIJ avoids the issue of emissions reduction credits transfer, it could be easily implemented. However, serious questions remain to be answered. How to produce real, measurable carbon emissions reduction through JI, the baseline determination, monitoring and evaluation, reporting, and other issues concerning JI are still unfolding through AIJ experiences. As Oran Young pointed out in his analyses of climate change negotiations, because the bargaining parties do not know for sure about the streams of benefits and costs flowing from the operation of different institutional arrangements, they have clear incentives to engage in an exploratory discourse designed to identify mutually beneficial institutional options rather than to secure the best possible outcomes for themselves (Young 1995).

Energy Conservation and Joint Implementation

Demonstration Projects

The two JI projects beginning in 1993, one in Mexico and one in Poland, co-financed by Global Environmental Facilities (GEF) and Norway, were intended to demonstrate JI arrangements consistent with the FCCC. Mexico's high efficiency lighting project offers compact fluorescent lamps at a subsidized price to encourage the use of energy-efficient lighting in two Mexican cities. Poland's coal-to-gas conversion project is designed to replace coal-fired boilers with a new gas-fired boiler and to install cogeneration units to produce heat and hot water (Anderson 1994). In both cases, the Joint Implementation project is negotiated by bilateral bargaining between one or two developed countries and a developing country or an East European country.

There are two primary criteria for selecting a JI project discussed in the literature. The developing country needs to make sure that the JI project is directly related to its development priorities. The GEF considers carbon dioxide reduction per dollar. It requires that the incremental global environmental benefits exceed the net incremental cost where net incremental cost equals to the incremental cost minus the incremental domestic benefit (King 1993). The next section exams how these rules could be applied to the situation of China and Japan.

China's Development Priority and Joint Implementation

Two of China's most pressing economic development issues are interrelated: electricity shortages and air pollution. Ideally, one would want to have both electricity and clean air. In reality, coal-fired power plants in the 1980s, growing at 8 percent annually, have contributed to serious air pollution—especially acid rain. Coal-fired power plants are among the largest coal consuming industries and more than 90 percent of SO_2 emissions result from coal burning. The.power industry plays a crucial role in economic growth and in raising living standard in China. In the past decades, China has successfully doubled its annual per capita consumption of electricity from 213 kWh in 1975 to 517 kWh in 1990 (Qu and Li 1994). Compared with more than 5,000 kWh in Europe and more than 10,000 kWh per capita per year electricity use in the United States, China feels it has a lot of catching up to do. China plans to increase its annual per capita electricity consumption to 1,000 kWh by early in the next century (Figure 1). Its population should be 1.3 billion people by then. Coal will continue to be the primary source of China's energy use. China now is producing and consuming about 1 billion tons of coal each year. It plans to increase its coal production and consumption 40 million tons annually in the next decade (Figure 2) (Ministry of Energy 1993).

Despite these increases, since the 1980s, energy production growth has lagged behind economic growth. This resulted in energy shortages, which in turn forced the Chinese government to pay closer attention to energy conservation. China realizes that its coal-fired power plants have great potential for increased efficiency. On average, Chinese power plants use 432 gram of

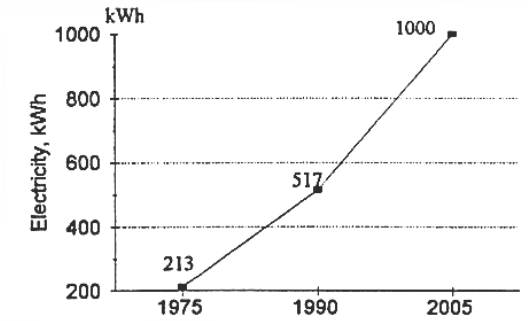

Figure 1: Annual per capita electricity use in China, 1975–2005

coal to produce one kWh electricity, compared to 330 g/kWh in power plants in industrial countries. Improving efficiency alone could save seventy to eighty million tons of coal per year in China. On the one hand, China faces a big energy shortage; on the other hand, there exists a large amount of energy wastage. Therefore, coal-saving, energy-efficiency improvement and energy conservation are development priorities in China. Consequently, efficiency improve-ment projects in the energy sector will be appropriate for joint implementation projects.

Economic growth and energy development in China have profound implications for global climate change. In 1975, China contributed 7 percent of the CO_2 emissions of the world. By 1990, this had grown to 11 percent. If it follows the traditional energy path, China will produce 22 percent of the world's CO_2 emissions by 2100, which is equal to the total world CO_2 emissions in 1990 (Figure 3) (Manne and Richels 1990). This would put a tremendous burden on the environment. China is not unique in the pattern of economic growth and pollution growth. Other rapidly growing developing countries, such as India and Brazil, also have similar problems. Every effort must be made to shift the developing countries away from the energy consumption/pollution paths taken by the industrialized countries. JI can be designed to achieve this goal.

Acid Rain Problem and Regional Environmental Cooperation

In Northeast Asia, the most pressing transnational air pollution problem is that of acid rain. The main sources of acid rain in the region are high level sulfur emissions from coal-burning power plants, especially in the northeastern and southeastern regions of China. Scientists in South Korea, North Korea and Japan believe that

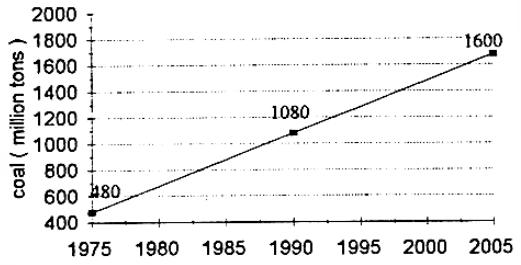

Figure 2: Coal production in China, 1975–2005

they suffer from acid rain originated from northeast China, although the Chinese government has not accepted this being the fact. A recent study, RAINS-Asia, funded by the World Bank and the Asian Development Bank, shows that China was the source of 11 percent of the total sulfur depositions in Japan, 16 percent in South Korea and 34 percent in North Korea (Table 1). In the summer, air flows from North Korea to China so that SO_2 emissions from North Korea contribute a 19 percent of sulfur deposition in China (Zarsky 1996). SO_2 emissions have increased at an annual average rate of 4.8 percent in China in the 1980s (Qu and Li 1994). Along with neighboring countries, China suffers huge tangible financial losses ranging from damage to crops, forests, soil and biomass, fish stocks and lakes, buildings and bridges, human health, and household appliances and tourist revenue losses.

Because the power plants are by and large government-owned, to reduce SO_2 emissions, the Chinese government has to come up with additional investment capital. But, the decentralization in China has led to the decline of the direct government investment in the electric power industry. In addition, many small coal-fired power plants have been built in rural counties since the 1980s. These small plants are high cost and highly polluting (Wirtshafter and Shih 1990). However, they are continually being built because the rapid industrialization in rural areas

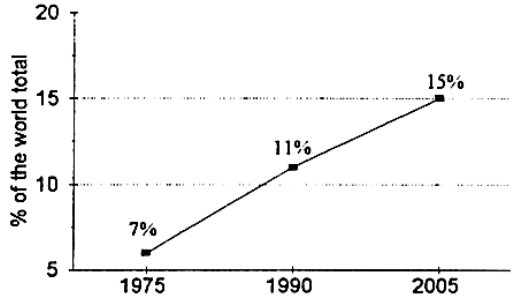

Figure 3: Carbon emissions in China as a percentage of the world total, 1975–2005

creates increasing demand for electricity unmet by the large-scale power plants.

In short, the energy efficiency improvement projects in the coal-fired plants are suitable candidates for a joint implementation project between China and Japan due to its impact on reduction of acid rain problem in Northeast Asia Region in addition to the global environmental benefit. JI project in this area link the short-term local environmental gains with the long-term global environmental protection objectives.

Recipient	Total deposition on recipient	Source China
China	6,390	6,210 (97%)
South Korea	198	32 (16%)
North Korea	184	61.9 (34%)
Japan	388	43.8 (11%)*
Ocean	2,870	1,120 (39%)

Table 1: Acid Rain in Northeast Asia: Country Sources of Sulfur Deposition, 1990 (unit: 1,000 tons)

Source: Carmichael and Arndt, "Long-Range Transport and Deposition of Sulfur in Asia," in Zarsky (1996).

*Corrected from the original, which contains a computational error indicating that China was the source of 37 percent of total sulfur deposition in Japan.

Bundling SO_2 and CO_2 Emissions Reduction with Coal Conservation Practices

Introduction to China's Current Air Pollution Control System

Since the late 1980s, China has adopted a series of laws and regulations for environment protection. China has a hybrid system which uses environmental standards (command and control approach), effluent fees (taxes), and pollution permits (emission rights). Of special interest here is China's air pollution permits trading experiment which can be extended to include global pollutants.

J. H. Dales proposed in the 1960s that property rights should be defined not as "property rights to air and water, but the use of air and water." A tradable pollution permits system can be created to manage the use of environmental services. An environmental regulatory authority would set an emissions target by restricting the quantity of permits. The permits would be issued and could then be bought or sold. As a market for these permits developed, supply and demand for the permits would determine the price, reflecting the opportunity cost of emission.

In the early 1990s, the pollution permits system was introduced to China, and the pilot projects reports on air pollution control of SO_2, TSP seem promising (NEPA, 1994a). As part of the pilot project since 1992, the Chinese EPA experimented with emissions permits trading in six cities. According to the Chinese EPA, the preliminary results are positive, and the experiments with emissions trading will be continued and extended to other pilot cities. The main attraction of emissions trading for the Chinese EPA is that it is an incentive-based method and provides a solution to the economic growth–environmental protection conflict, especially for the heavily polluted cities. The basic approach of the emissions trading in China is similar to the United States EPA's offsets policy under the emissions trading program. In the pilot cities, the Chinese local EPA required firms with new plant construction or expansion to purchase emissions permits. All new or increased emissions must be offset by reducing the existing emissions. In order to obtain EPA's approval, new plants must pay for the existing emissions abatement projects. For example, the local EPA would ask a coke-oven plant (new project) which is under the local mining bureau, to invest in a gas supply system to replace the coal cooking stoves of the mining workers' families and the surrounding local residents. The net result of the trading created a win-win situation where both the economy and the environment improved (NEPA, 1994b). From this already accepted air pollution control system, new approach to solve the global environmental problem may evolve.

Connecting Local Pollution Control to Global Climate Protection: Three Forms of China–Japan Joint Implementation

China's current endeavor to control local air pollution has profound implications for international cooperation in regional and global environmental protection. I will introduce three forms of carbon emissions reduction projects that are already in practice in China. Three types of joint implementation projects could be adopted by China and Japan to achieve carbon emissions reduction:

- capital investment in revamping the old power plants

- establishment of energy-service companies to improve efficiency and to reduce the pollution of new, small, coal-fired power plants in rural counties in China
- sponsorship of a pilot project for adding CO_2 emissions permits to the existing SO_2 emissions-permit system in a northeast city in China.

A project-based Joint Implementation project is similar to that of Poland Coal-to-Gas conversion project and the two AIJ Japan projects in China. It could provide help to ease capital constraints on revamping the outdated inefficient polluting power plants. Energy service companies would disseminate information on clean technology and overcome institutional barriers in local clean technology R&D. The emissions permits system could expedite the removal of energy price distortion. Because the capital investment type of project is on going and familiar, I will focus on the explanation of the latter two types of joint implementation projects proposed here.

The joint implementation project could fund the establishment of energy service companies. The energy service company has already emerged in China. Shacheng city energy management company is an example. In their paper, Levine and Liu describe the experience of the first energy service company in China:

> In spite of the lack of energy-conservation funding and the lack of attention to the environmental protection at local level, some local governments have taken initiatives to pursuit innovative policies in energy-conservation and the environmental protection. In Shacheng city a local energy service company raised funds for energy-efficiency investments and paid the loan back from savings that the investments produced. The local electricity management office gave a 250,000 yuan loan to the Second Transistor Factory to develop an energy-saving switch for use in the textile industry. The electricity-management office gave the first group of buyers of such switches a 50 percent discount as energy-saving incentives. Even with the 50 percent discount, however, some enterprises still could not afford them because of lack of capital. In these cases the office bought the new switches for the enterprises, but the office sold the saved electricity to other electricity buyers until the electricity savings had completely compensated the office for the cost of new switches (Levine and Liu 1990).

In the example of Shacheng city, the energy service company initiated R&D, purchased the energy-saving devices and placed them in firms which would not have used the devices due to lack of information or capital constraints. This Chinese local energy service company accomplished a very similar goal as the GEF-Norway co-financed Mexico high efficiency lighting joint implementation project. The Mexico high efficiency lighting project procured and placed in households in two Mexico cities 1.7 million compact fluorescent lamps over a two-year period. It is interesting to note that according to the GEF marginal cost calculation, the net marginal cost of the JI project would be negative. This is because it is simply economic to use a fluorescent lamp. It uses four times less electricity and has twelve times longer life hours. Aside from this is the global and local environmental benefit from energy saving.

Three factors prevent the residents of Mexico from using the new lamp immediately. The electricity price is low; the initial purchase price of the new lamp is prohibitive ($10 versus $0.75 of the regular bulb); the manufacturers do not have incentives to advertise the lamp because the brand name is not very important. The joint implementation project provided financial resources to overcome the informational and institutional barriers. The goal of this JI project is to shift Mexico on a lower emission path from the investment in residential lighting energy conservation. In this sense, the marginal cost of the project and the marginal benefit to the global environment are positive (Anderson 1994). The readers would find similarities in the functions provided by the Mexico high efficiency lighting JI project and the Chinese Shacheng city energy service company.

Japan, under the joint implementation, could fund energy service companies in China to develop more efficient motors, furnaces, transformers, blowers, pollution control devices etc., which can be used in the old Chinese coal-fired power plants and the new small coal-fired power plants. Low-tech, locally suitable, inexpensive technology research and development is terribly needed in China. Two chief engineers of the Chinese coal-fired power plants which I visited expressed the same view. In addition, this type of joint implementation answers the concern that JI projects might lead to pressure from investor countries or companies to accept investor owned technology which may not be the most appropriate for the developing country.

In addition to the capital investment and the energy service company, I propose the institution of a carbon emissions permit system in one of

the Chinese pilot cities for air pollution permits as a joint implementation project with Japan. No new institution needs to be established at the first stage. Research for the project feasibility is needed. I suggest that we add on a pollutant, CO_2 to the existing air pollution permit system. CO_2 emissions permits can be bundled with SO_2 emissions permits by the measurement of the use of coal. The current experiment in Xuzhou, Jiangsu Province provides a good example how air pollutants can be reduced by controlling coal use per unit of output.

Xuzhou City focuses on the aggregate amount of TSP (Total Suspended Particulate) emissions from sources within Xuzhou area. Their main approach is to lower coal consumption per unit of output in major coal burning industries. The permits of coal input per unit of output are issued to each firm based on the best practice of the existing technology, so that the permits include an emission target and a per unit of output coal consumption target. In this way, air pollution control focus shifts from pollution treatment to pollution prevention; that is, instead of emphasizing the installation of pollution treatment equipment at the end of the production process, the pollution is to be reduced by producing less of it.

The coal-saving approach is easy to understand, with emissions reduction easily quantified and monitored. Xuzhou city EPA required the installation of coal-burning input meters and pollutants measurement meters. In addition, Xuzhou connected workers' bonuses to coal consumption: for every ton of coal saved, the operator can earn a bonus of six to ten yuan. Xuzhou EPA reports that coal use per unit of output in the forty-five firms participating in the permits system dropped by 12 to 50 percent after the permits system was established (Xuzhou City Environment Protection Bureau 1994). Thus, it appears that the permits system, which focuses on coal saving, can be economic for the firms. At the same time, it contributes to the reduction of local air pollution, alleviates the impact of acid rain on neighboring countries (if instituted in the northeast China), and enhances global climate protection.

To Have or Not Have a Market for Joint Implementation

Investigation of the two JI demonstration projects in Mexico and Poland shows that the information needed to calculate the domestic benefits from the JI project is not easy to obtain. Other factors such as price expectations, complexity of the technology being transferred, future market advantage and international reputation and relations all play a role in the bilateral bargaining process. Therefore, the negotiated price of a JI could end up at almost any level (Anderson 1994).

An alternative approach is to establish an auction market. A clearinghouse jointly organized by Japan and China could be established to provide several major functions: to screen potential emissions offsets projects, to record the information of trades, to post the information about the projects for sale, to determine the rules of trading and to supervise the auction. The market demand and supply will determine the price for the joint implementation projects.

An Experimental Investigation of Two Emission Permits Systems

The market trading rule plays an important role for the distribution of trading surplus (profits) between buyers and seller. The results of laboratory experiments I conducted in China and the United States suggest that the trading rule based on the ability to pay is inferior to the standard uniform pricing rule. Based on the Chinese SO_2 emission permits trading experience, there is a tendency to match the buyer with higher willingness to pay with a most costly (larger) abatement project. "The rich should pay more" is a widely accepted concept in China and among other developing countries. The Chinese EPA may have the good intentions of increasing the trading volume and therefore emissions reduction, but it may backfire by lowering the trading price and volume.

I conducted five sessions of classroom market experiments on the market trading rules in the Wuhan University Research Institute of Environmental Law and five sessions of experiments at the University of California, Santa Cruz (UCSC). The laboratory experiments evaluate the matching rule (ability to pay) compared with the standard uniform pricing rule. The project was inspired by Timothy Cason's experiments on the United States EPA's SO_2 emissions trading rule, where the highest bid is matched with the lowest offer. Cason found that the United States EPA's matching rule distorts the incentives of the buyers and sellers, resulting in poorer market performance outcome compared to the uniform pricing. Chinese EPA's matching rule is related to that used by the United States EPA but differs in some crucial respects. The United

States EPA's intention is to allow the original holders of the emission permits to benefit most from the trading. In comparison, the Chinese EPA intends to maximize trading volume in order to achieve the maximum amount of emissions reduction. It also wants to benefit the sellers of the permits since they are the existing sources of pollution. This is especially relevant to international carbon emissions trading because the sellers are the developing country parties. In contrast to the United States EPA's matching rule, the Chinese EPA matches the highest bid with the highest remaining ask (offer) less than or equal to that bid. Buyers pay their bid prices and sellers receive bid prices.

My experiments in both China and the United States with the professional subjects and student subjects show that the traders' cultural identity and international demand shocks have little impact on market outcome. In a uniform price auction market such as used in New York Stock Exchange, buyers submit bids (signaling willingness to pay) and sellers submit asks (signaling willingness to accept) for a traded commodity. Bids and asks are aggregated into demand and supply curves and a uniform clearing price is found at the intersection of demand and supply. Compared to uniform pricing, the matching institution results in greater incentives for traders to manipulate the transaction prices, which leads to lower efficiency, lower prices, lower buyers and sellers profits and more variable trading volume.

The Chinese EPA's matching rule was re presented in our classroom market experiment, as shown by the recorded trading. The theoretical implications of matching institution (rule) is similar to that of uniform price auction. For example, given a list of true value and cost for four buyers and four sellers, the reported values are lower and the costs are higher than their true values and costs. The data in Table 2 are generated from three periods of matching market trading in a pilot experiment at UCSC. The true value (V) and costs (C) are indicated by connecting lines.

The bids and asks are submitted simultaneously and posted on the blackboard except for the true values and costs, so that the traders can observe the market transaction price and quantity. However, they do not know the values and costs of other traders. In the classroom market, we mimic the carbon emission market trading situation where the number of traders are small, and the public information is limited only to the posted market transaction prices. The transaction prices for period 1 are 53, 32, and 22.5 and they are paid to the sellers who asked for 42, 25, and 7 respectively. Three points should be noticed from the data. First, all buyers bid below their true values and sellers above their costs. Second, the buyers who won the transactions regret ex post they did not bid lower. So in the second period, all three winners bid lower than before. Third, the sellers learned after the first period that if they ask higher they may be matched with higher bids. Thus, two out of three winning sellers asked higher in the second period.

The matching market is similar to k-double auction except that the pricing rule provides much stronger incentives to both buyers and sellers to choose their bids and asks strategically. This generally will lead to inefficient outcomes. We can see from trading period 3 that only one volume is traded since the sellers are asking too high (in order to be matched with high price bidder), and the buyers are bidding too low prices. Notice that by design (True V and True C), four transactions are expected; however, the incentives created by matching rule to manipulate the transaction prices led to the overall lower trading price, more variable trading volume and lower sellers and buyers profits of the matching trading market. Sellers achieved 87 percent of competitive equilibrium profits (maximum sellers' profits) when the uniform pricing rule was used, compared to 73 percent under the matching institution (Rich, 1996).

The lab experiments offers a valuable insight in that the fairness and efficient emissions reduction can be relatively better achieved by a standard uniform pricing auction market.

Although in practice, the Chinese EPA uses an administrative matching process rather than an explicit matching market for emissions rights trading, the distortions in incentives are captured well by the classroom experiments.

In reality, the auction market is not alien to the Chinese. In the past fifteen years of market-oriented reform, the Chinese routinely hold auctions for large industrial project technology and equipment purchases. In 1992, the Chinese government auctioned cultural relics in Shanghai, where the auction market was open to international buyers. At community level, some villages have conducted auctions to the annual contract of the village-owned enterprises. The classroom market experiments conducted in China indicate

True V	True C	Period 1		Period 2		Period 3	
		Bids	Asks	Bids	Asks	Bids	Asks
55	54	53	66	45	55	40	54
45	38	32	42	30	47	30	39
36	22	22.5	25	20	34	25	34
26	6	3	7	15	7	23	33

Table 2: Experimental investigation of two emissions permits systems: matching market trading

that traders (professional or student subjects) without any experience of auction can learn how to trade in less than a hour's time.

Evolving Market for Joint Implementation

From International Carbon Emissions Offsets to Emissions Rights Trading

Due to the slow progress in international negotiations on climate change, the international emissions rights allocation may not be decided any time soon. During the transitional period before an international (regional) carbon emissions rights trading market is established, joint implementation can take the form of emission offset, that is, Japan can limit its domestic growth of carbon emissions by requiring large, new stationary sources of CO_2 emissions to compensate by offsetting investment domestically or in developing countries. This idea was originally proposed to the U.S. Congress in 1991 as an Amendment to the Clean Air Act (Roland 1992). Although China has not adopted a national emission target, offsets investment represents a side payment necessary to make it politically feasible for China's participation in the international efforts to combat global warming.

The offsets investment can be made by a project-based approach such as current AIJ and the two GEF and Norway demonstration projects or by funding the institutional reform of establishing carbon emissions permits system. This can be achieved either by bilateral negotiation or by auction market trading. A clearing house established jointly by Japan and China can select carbon emissions abatement projects and auction them off using a uniform pricing rule.

Two-Tier Carbon Emissions Trading Market Systems in China

As the first step to the evolving market of emissions rights, China can select one of its pilot SO_2 emission trading cities, preferably in the northeast China, and open the trading of SO_2 emissions permits to the Japanese buyers. The SO_2 emission rights purchased by Japan can be retired which will help Chinese city to achieve net reduction of SO_2 emission.

To link regional environmental management cooperation in reducing acid rain problem to global climate protection, the maximum coal input per unit of output requirement could be added to SO_2 emissions permits such as in the Xuzhou permits system. When the offsets projects achieve the dynamic coal consumption reduction, the amount of coal saved from the adopting the CO_2 emission permits system should be recorded as the carbon emissions reduction. This will raise incentives, and therefore consciousness, to save coal.

The advantage of CO_2 emissions permits over a project-based CO_2 emission reduction project is that it would create wider and greater impact on firms' behaviors in energy conservation and raising consciousness to the global environmental problem. It can be implemented as a coal saving/ energy conservation program so that it would be consistent with the Ninth five year plan of China. The Ninth five year plan calls for changing style of economic growth from "slipshod" (cufang xing) into a sustainable and refined approach. Energy conservation, energy efficiency improvement and acid rain reduction are at the top of Chinese national agenda.

The basic elements of carbon emissions permits system will be similar to that of the Xuzhou experience. The focus would be on reducing the coal consumption per unit of output in coal-fired power plants and other high coal-consumption, high-pollution industries. The difference between a single SO_2 emission permit and a combined SO_2/CO_2 emissions permit is that the amount of coal saved through implementing the CO_2 emission permits system now could be converted into the rights of CO_2 emission and sold to the permits buyers in China and in Japan as carbon emissions offset. The Xuzhou experiment has shown that coal-consumption saving at each firm can be substan-

tial and it can be effectively measured by simple monitoring devices.

China does not have to restrict its economic development by introduction of a domestic carbon emissions permits program. The CO_2 emissions permits system offers a management mechanism to allocate a scarce resource, coal, efficiently. The Chinese State Environmental Protection Bureau can cooperate with the Ministry of Coal and Ministry of Electricity to allocate carbon emissions permits bundled with coal quotas. The carbon emissions permit system could generate energy savings and air pollution reduction, as well as allowing China to accumulate knowledge of carbon emissions reduction through permits system.

The national carbon emissions permit system recommended in this paper could prepare China for entering into international emission rights trading in the future. The domestic CO_2 emissions permit system can be implemented by a two tier market system. At local/regional level, the local EPA would supervise CO_2 emissions permits issuing, monitor the results, collect and record coal/emission savings and administer emissions rights auction among the firms. A national clearinghouse would reduce transaction costs. The State Bureau of Environmental Protection in China could set up a national clearing house to auction off new permits (bundled with coal quotas) annually and allow the local EPA (regional authorities) to trade the emission rights generated from coal conservation. The information collected by the national clearinghouse would form a natural basis for a Northeast Asian regional carbon emissions permit trading clearing house.

Because currently China does not have obligations under the FCCC to reduce carbon emissions, China does not need to set a national carbon emission limit, which it opposes. However, the domestic carbon emissions permits system would assign property rights of carbon emissions to firms. Each right commands a market value which gives incentives to the firms to use the most energy efficient technology and the least cost technology to meet carbon emission target. At a later date, China may become a signatory country of a protocol on climate change. It will be allocated carbon emissions rights by the international community authority. Then, it can participate in international emissions rights trading. Some developing countries fear that the industrialized countries might buy up a large share of emission rights at an early stage of trading when emission permits are cheap. The emission permits would become expensive and this could limit developing countries' economic growth. This risk can be reduced by allowing countries to borrow and lend emission rights as well.

The Role of the United States in Japan–China Joint Implementation

The United States–Japan high-level talks on Asian security issues have included environmental protection in Asia as one of the key areas for cooperation. Both Japan and the United States face domestic political constraints to implement carbon emissions reduction at home, so they are interested in Joint Implementation programs with China. Other factors also make Joint Implementation attractive to the United States. The relationship between Washington and Beijing has deteriorated over issues of human rights, Taiwan and intellectual property rights. Environmental protection becomes a precious area where two countries' leaders may be willing to compromise.

Although Japan has the ambition to play a leadership role in the Northeast Asian affairs, it still needs the United States as a partner because of Japan's past relationship with Asia. Feelings against Japan still function as an important determinant in regional relations. The emotional legacy often looms up to strain bilateral relations (Shibusawa 1992). Partly because of the absence of other political means, official development aid has become the major foreign policy instrument of Japan since the 1970s. It is likely that the Japanese government would provide additional funding for the joint implementation project. The United States has expertise in emissions permits trading which could facilitate a joint implementation project that institutes a Chinese domestic CO_2 emission permits trading system. The experiments of domestic CO_2 emission permits system in China, if successful, could be introduced to the United States and Japan.

Global climate protection could become an important area where the United States and Japan can cooperate with China, finding common interests, especially over energy sector reform and development. As a means of achieving moral and emotional reconciliation with their past, Japan–China joint implementation in carbon and sulfur dioxide emissions reduction will not only improve regional and global environmental protection, it will also enhance the economic inte-

gration and security in the Northeast Asian region.

REFERENCES

Anderson, Robert. 1994. Joint implementation of climate change measures: An examination of some issues. Working paper, The World Bank (January).

Barrett, B., and R. Therivel. 1992. *Environmental Policy and Impact Assessment in Japan*. New York: Routledge.

Imura, H. 1993. Japan's efforts in the environment with sustained growth. In *The Pacific Rim Environmental Challenge: Directions for the 1990s*, edited by H. Kendall. Berkeley: University of California Press.

Jiang, Zemin. 1996. Speech at the fourth meeting of National Environmental Protection. *People's Daily*, July 19. (In Chinese)

King, Ken. 1993. The incremental costs of global environmental benefit. Working paper no. 5, Global Environment Facility.

Levine, Mark, and Liu Xueyi. 1990. Energy conservation programs in the People's Republic of China. Lawrence Berkeley Laboratory, LBL 29211 (August).

Manne, Alan, and R. Richels. 1990. Global CO_2 emission reductions: The impacts of rising energy costs. *The Energy Journal* 12, no. 1.

Ministry of Energy, PR China. 1993. *Five Year Rapid Development of Energy Industry, 1988–1992*. Beijing (March). (In Chinese)

NEPA, PRC report. 1994a. Application of incentive-based methods in the system of pollution permits. Internal report (November). (In Chinese)

NEPA, PRC report. 1994b. Working report of nationwide pilot project of atmospheric emissions permits system. Internal report. (In Chinese)

NGO Newsletter. 1995. China faces flooding. *Eco Newsletter* 7 (April 4).

Parker, Paul. 1992. Linking environmental policy and energy technology to coal trade: Japan and the Pacific coal flow expansion initiative. *Pacific Economic Paper*, no. 204. Ontario: Australia–Japan Research Center, University of Waterloo (February).

Qu, Geping. 1995. Speech at East Asia and Pacific Rim climate change meeting. *People's Daily*, February 19. (In Chinese)

Qu, Geping, and Li Jinchang. 1994. *Population and the Environment in China*. Boulder, Colo: Lynne Rienner.

Rich, Changhua Sun. An experimental investigation of two systems of emissions permits trading. Dissertation presented at Northeast Asia Regional Cooperation: China–Japan Joint Implementation of Carbon Emissions Reduction, Santa Cruz: University of California, Santa Cruz, 1996.

Roland, Kjell. 1992. From offsets to tradable entitlements. In *Combating Global Warming Study on a Global System of Tradable Carbon Emission Entitlements*. New York: United Nations.

Shibusawa, M., et al. 1992. *Pacific Asia in the 1990s*. New York: Routledge.

Wirtshafter, R., and Ed Shih. 1990. Decentralization of China's electricity sector: Is small beautiful? *World Development* 18, no. 4.

Xuzhou City Environment Protection Bureau. 1994. Working report on Xuzhou city pilot project of air pollution emission permits system. (In Chinese)

Young, Oran. 1995. Negotiating an international climate regime: The institutional bargaining for environmental governance. In *Global Governance*. Cambridge, Mass.: The MIT Press.

Zarsky, Lyuba. 1996. Environmental cooperation and sustainable development in Northeast Asia. *Joint U.S.–Korea Academic Studies* 6.

FOREST RESERVES IN LATIN AMERICA

ENVIRONMENTAL CONFLICT, REGULATION UNCERTAINTY, AND FOREST STOCK RESPONSE

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Abstract

This paper discusses the implicit effects of the anticipation of forest regulation, in terms of deforestation and expected price variations. The main implication is that forest regulation uncertainty generates perverse consequences in the forest exploitation itself, an exploitation that is further exacerbated by public policies that subsidize and/or directly invest in the construction of transport and commercial infrastructure. These issues are particularly relevant for Latin American countries, where political and social pressure produces great uncertainty in future forest management laws. Policy recommendations are: (1) minimize uncertainty about the content of future forest laws, (2) provide signals of future positive compensations for forest preservation measures taken by private owners, and (3) assess the implications, in terms of deforestation impact, of public investments and subsidies in forest road construction, transport facilities, and commercial infrastructure: government policies towards transport infrastructure can encourage deforestation."

Introduction

The subject of forest regulation and its effect on deforestation is a central issue for Latin America, where the coexistence of political instability and increasing environmental concern imposes significant uncertainty in the forest stock decision making process.

The anticipation of forest regulation by private forest owners or managers generates perverse effects on the forest exploitation decision: the threat of restrictions makes forest investors reduce their forest inventory, as their rational reaction to increased risk. Just the possibility of forest restrictions triggers a perverse reaction in private forest cutting rates, a reaction that could be strong enough to make it necessary to eventually impose the regulation, in order to prevent further forest and land deterioration. In this case, the expectation of a regulation can be a "self-fulfilling"

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prediction. This negative effect on forest preservation is further aggravated by transport infrastructure investments that are either undertaken or subsidized by governments, facilitating accessibility to slow-growth forests.

This paper argues that forest regulation uncertainty causes forest price volatility and a reduction in standing forest availability in the long run. This issue raises questions on the effectiveness of forest cutting restrictions, if anticipated by private forest owners, and of long parliamentary discussions on forest laws, particularly regarding the commercially fragile native forests resources of Latin America. Slow-growth, native forests are vulnerable to market signals, particularly if the existence of commercial infrastructure makes their exploitation cheaper, and alternative uses for the land more profitable.

Specific policy recommendations are (1) minimize uncertainty about the content of future forest laws, (2) provide signals of future positive compensations for forest preservation measures taken by private owners, and (3) assess the implications, in terms of deforestation impact, of public investments and subsidies in forest road construction, transport facilities, and commercial infrastructure.

These policy recommendations are targeted at providing a better institutional setting with respect to forest preservation issues, as well as guidelines for domestic and international organizations concerned with the deforestation trend, particularly in politically unstable Latin American countries. A central message of this paper is that policy makers should be careful in assessing the effects of forest law revisions and government investment or subsidy policies in forest regions; the implicit implications generated by the anticipation of forest management restrictions need to be understood and assessed, whenever possible.

In this paper I present the general problem, discuss specific results, and identify policy implications. The results presented in this paper are based on a formal model of forest stocks and prices determination under conditions of uncertainty in future forest regulation (Bobenrieth 1996). This model was constructed to fit the setting of politically changing Latin American countries, where forest laws have been dramatically modified during the last several decades, and are expected to continue to do so in the future, the pressures produced by economic growth and environmental and in particular forest degradation concerns are increasingly taking a predominant role in policy discussions.

According to the World Resources Institute (1994), between 1980 and 1990, tropical forest areas have been shrinking an average of 15.4 million hectares per year, and the area of degraded and fragmented tropical forests may be considerably larger than the actual deforested area. This concern is particularly true in Latin American and Caribbean countries, where in the 1981–1990 period there was an average annual tropical forest loss of 7.4 million hectares, a figure that stands high, compared for example with the 4.1 million hectares yearly rate observed for the same period in Africa, or the 3.9 million hectares of tropical deforestation rate in Asia and the Pacific (Food and Agriculture Organization of the United Nations, FAO 1993). In terms of forest biomass losses, more than 50 percent is contributed by the Latin America and Caribbean region, 30 percent by tropical Asia and 20 percent by tropical Africa, as shown in Table 1.

Region	Biomass Loss (millions of tons)	Percent of Total
Africa	479	19
Asia and Pacific	732	29
Latin America and Caribbean	1,303	52
Total	2,514	100

Table 1: Tropical Forest Biomass Losses Due to Deforestation (1981–1990)

Source: FAO (1993), Forestry Paper No. 112.

Domestic governments, as well as the international community are increasingly concerned with the deforestation trend. Domestic preservation laws are being discussed and implemented in Latin American countries, and internationally, there has been a growing pressure on forest conservation: the 1972 Stockholm United Nations Conference on Environment and the United Nations Environment Programme are early reactions to global deforestation and more general environmental issues. The World Conservation Strategy of the 1980's, sponsored by the International Union for Conservation of Nature and Natural Resources (IUCN) and the World Wildlife Fund (WWF), the United Nations Educational Scientific and Cultural Organization (UNESCO), and the (FAO), stressed the relevance of conservation to achieve sustainable development. The Tropical Forestry Action Plans sponsored by FAO and the WRI and the Brazil Conference on Environment and Development of 1992 are more recent examples of international coordination efforts addressing the deforestation problem.

The negative consequences of deforestation are known and well documented: soil degradation and desertification, decreasing productivity generating food insecurity, forest input scarcity, water quality deterioration, watershed degradation, global warming, natural environment destruction, species extinction, etc. All of these consequences imply that it is not possible to view commercial forest exploitation as a separate issue from its environmental effects. It is indeed the case that there are competing uses for the forest, not all of them internalized by the private owners. Indeed, environmental damage that is generated by forest exploitation highlights a conflict over

the forest management strategy, including the forest cutting rate. A comprehensive treatment of the subject needs to go through an understanding of the long-term implications of changes in land use, a topic much more complex than the assessing of the commercial value of standing forest. In this context, forest management restrictions are widely perceived as necessary measures to preserve forest resources.

Forest management regulation is an important issue for Latin America. As governments become more concerned with forest reserves and the forest industry increases its size and relevance, the conflict for competing uses of the forest is more evident. Traditional forest conservation laws are being revised, and environmental protection is now an important part of the political agenda. It is for example the case of Chile, where the traditional *Ley de Bosques* of 1931 has been almost completely modified, with changes that include direct control and conservation of the natural resource. Also for the case of Chile, a major forest legislative initiative, *Proyecto de Ley de Bosque Nativo y Fome-Zto Forestal,* has been extensively discussed and it is about to be approved by the Chilean senate. This forest law will provide economic incentives for native forest improvement, but it will also restrict cutting and particular land management practices. The question is not only whether total native forest stocks can sustain the current consumption rate, or whether there is a natural relative efficiency to forest production in Latin American countries: private economic returns on the forest business are particularly high in Latin America, where some countries such as Chile and Brazil have a comparative advantage to grow industrial wood more cheaply than other forest-producer countries (Spears 1988). Rather, the question is whether more regulation can provide higher standing forest stock levels.

As shown in Table 2, the issue of native forest preservation is not only of academic interest, as 80 percent of the total Chilean productive forests are native. Therefore, restrictions on native forest lands could have significant economic consequences. Moreover, the competition for land is not limited to the traditional agricultural vs. forest alternatives, but it also includes conflict between native vs. plantation forest uses.

Considering the very nature of forest production, where time is a fundamental input, forest regulation uncertainty can be detrimental to forests themselves. In particular, the threat of future regulation (or future enforcement of current nominal regulation) can affect the decision on forest cutting patterns, from a long-run forest production plan to a short-run oriented exploitation, where the objective becomes the maximization of short-run profits, instead of a long-run-oriented forest strategy. Private forest owners and forest concessionaires react to possible future restrictions by structurally modifying their forest exploitation plans, often concentrating on short-rotation plantation, when rationally managed stands of native species could be economically beneficial in the absence of external restrictions, and socially optimal. The issue is that private forest owners can be expected to react to perverse economic incentives. If these incentives are strong enough, this could rapidly increase deforestation rates.

Type of Forest	Area (hectares)	Volume (millions of cubic meters)
Native forest	7,493,200	891.0
Plantations	1,747,523	221.8
Total	9,240,723	1,112.8

Table 2: Chilean Productive Forests (December 1994)

Source: Instituto Forestal, Chile, 1995.

The most evident case of rapid deforestation in Latin America is Brazil, where government policies have been an incentive to deforestation. Historically, the tax exemption on agricultural income, land allocation rules, the progressive land tax, and the tax credit mechanism, all have provided incentive for the conversion of forest land into agricultural use (Binswanger 1989). The incentive for deforestation is further aggravated by uncertainty in public policies toward forest preservation: potential government forest conservation measures would possibly curtail the ability to use forest land. Therefore, there is an incentive to rapidly deforest areas, even in locations where the agricultural operation would not be justified in terms of short-run profit maximization; the prospect of a permanent loss of the land's rent in its best alternative (non-forest) use is clearly a more powerful incentive than the short-term agricultural return itself. This issue is particularly relevant if forest regulation actually implies a permanent prohibition of forest cutting, implying a loss of the option value associated with non-forest commercial future uses of the land.

The result in terms of deforestation in the Amazonia region are dramatic: as of 1975, only 0.6 percent of Amazonia had been cleared, whereas later estimates show that by 1988 the total deforested land had increased to 12 percent in that region (Mahar 1989).

More generally, the absence of legal rights on the land (or secure contracts) is an incentive for over exploitation and land conversion from forestry to agriculture. Many tropical forests in Latin America are of government property, but the actual land managers are indigenous populations or squatters without legal rights, and therefore without the full incentive to protect the long-run productivity of the forest. Perverse consequences are generated by the potential of effective government forest protection, which reinforces the incentive for informal exploitation before the forest guards enforce the protection (Hyde, Newman, and Sedjo 1991). There is a large literature

on the effects that forest regulation and tenure have on forest exploitation. Feder, Onchan, Chalamwong, and Hongladarom (1988) and Fortmann and Ridell (1985) explore the effects of tenure contract on incentives for exploitation and investment in forest stocks.

The literature on forest management is rich on exploiting the particular issues that differentiate forest investment from other kinds of financial investments. The standard forest harvesting problem is stated in terms of the Faustmann rotation model (1968), which has been generalized in many directions, according to the specific research question of interest. Well known contributions include Samuelson (1976), Lofgren (1983), and Mitra and Wan (1986). Particular works aimed at uncovering the characteristics of the rotation period that is optimal from a social perspective, considering forest external benefits, include Hartman (1976), and Niklitschek and Bobenrieth (1992).

Forest valuation (and therefore deforestation cost) has been studied from several perspectives. The demand for forest stands can be conceptually understood as a derived demand, obtained from the consumption demand for the final product(s). A substantial literature addresses the problem of derived demand valuation of forest stocks, as well as elasticity determination of price transmission from the market of the processed product to the market of the basic forestry input. A review of this literature is provided by Hyde (1984).

Description of the Model

The basic model I use to draw the main conclusions and policy implications is a very stylized description of reality. It is simple, but powerful enough to identify the issues raised by the anticipation of regulation and by direct or implicit government action in the building of commercial infrastructure.

Recent advances in the literature on commodity prices provide an adequate, self-consistent framework to study the simultaneous price-stock determination in a stochastic context. From this perspective, it is possible to model private forest management in terms of the current and expected future economic environment, applying the commodity storage paradigm (Williams and Wright l991, Deaton and Laroque 1992). This literature stresses the relevance of the intertemporal linkage of prices and stocks, both being endogenously and simultaneously determined by the rational action of the entire market.

The main contribution of this dynamic storage structure is to provide an internally consistent modeling approach to understand the stock-carrying decision when there is uncertainty about future realizations of supply and/or demand shocks, and when there is a non-negativity constraint on total stocks. It is this non-negativity constraint what transforms a possibly linear solution for stocks and prices into a non-linear one. Prices and forest stocks cannot simply be assumed to increase sufficiently in each period (in expectation) to justify positive carryover of harvestable stocks, since they are determined by current and expected random shocks that could possibly create economic conditions under which complete stock exhaustion could be optimal from a private perspective.

Based on the commodity storage paradigm, I develop a model of forest stocks and prices formation, explicitly introducing expectations in the model. This model is an extension of the models of Williams and Wright (1991) and Deaton and Laroque (1992), and its solution relies on the stochastic dynamic programming algorithm (Bobenrieth [1996] provides a full description of the model and formal results).

Mature, commercially exploitable forest stands can be interpreted as the available stock, ready at any particular time period to be exploited. The decision of a profit maximizer, forward looking, rational investor, to carry commercial forest stock from one period to the next is based on the comparison between today's net price and the expected net price for next period, when the cutting decision will again be assessed (prices are understood as being net of exploitation costs). Moreover, even if individually the forest owner cannot affect their relevant market price, the market behavior as a whole does affect both current and expected price. Given a negatively sloped demand function for every period, less consumption today for the entire market implies a higher current price, as well as a lower expected price for next period. This intertemporal relationship of prices is fundamental for the development of a consistent framework to study deforestation, as we can expect that private forest owners will respond to economic incentives.

Individual forest investors are assumed to have internally consistent expectations on future prices and stock levels (what is usually called "rational expectations"), and their stock maintenance decision is taken based on those expectations. This model allows for the possibility of government intervention, in the form of an exogenous restriction that constrains the forest management strategy, even though not necessarily the total cutting amount in the long run, of a private forest owner. Specifically, at every arbitrary date there is a positive probability that the forest stand will be subject to regulation in the future. The rational action of forward-looking agents washes away intertemporal arbitrage opportunities, a statement that has strong empirical implications in this context of an uncertain regulation.

Maintenance of the forest stock from one period to the next can be understood as a storage activity,

which is a special kind of production, as described in Williams and Wright (1991), transforming "forest available now" into "forest available later," with the transformation taking place over time. A special feature of the forest storage is that the stock grows (naturally) over time.

Forest initial total availability can either be consumed or stored, and it is by definition equal to storage carried from last period (properly adjusted by natural growth and forest losses due to fire, disease, etc.) plus new forest stock ("production") that becomes available for exploitation (mature, commercially exploitable, and/or allowed to be exploited for commercial purposes). Forest storage is an increasing function of total initial forest stock availability. These storage units are standing forests with timber of a size and quantity that is available for commercial consumption, but which has not been exploited at the given date. The storage decision is reversible in the future, provided that there is no damage to the stock.

For Latin American native forests, it is often the case that this "production" variable is a function of time and government action: forests are being exploited and/or destroyed as the forest and the land become commercially accessible. In particular, road construction, port investment and commercial infrastructure, while encouraged and often subsidized by governments, provide the incentive to exploit forest stands that would be otherwise considered not accessible for commercial purposes.

The natural growth rate of native forests in Latin America is in general low, as compared with the financial interest rate. Nevertheless, even in such a case a rational profit-maximizer private forest owner could still want to keep the forest, if the price is expected to increase in a compensating fashion. More precisely, the forest natural growth rate is not the only factor to consider by a private investor in order to decide whether to exploit the forest or not, but more importantly, it is the appreciation of the forest's net value that matters the most in the cutting decision.

The intertemporal equilibrium implies a set of complementary conditions. In words, these necessary conditions mean that discounted expected profits from the marginal unit of forest storage cannot be positive. If such were the case, speculators would increase their holdings of standing forest stocks, thus bidding up current price and reducing the expected price for next period, until an equilibrium is reached. If at zero storage the expected price is lower than the current price, the commercial forest stock is depleted, and no further adjustments are feasible, due to the impossibility of borrowing commercial forests for the market as a whole.

What are the effects that changes in total forest availability have in forest exploitation and in forest preservation? The answer to this question is relevant to the study of deforestation, because time-volatility in prices and expected prices produces changes in forest availability over time, with implications in terms of forest exploitation rates. These results, which I now present, are standard from the general rational expectations storage paradigm, they are fairly intuitive and insightful to the study of forest stocks dynamics.

A higher total market availability level induces competitive forest investors to simultaneously increase consumption and forest preservation. The intuition is that a more abundant total commercial forest stock makes it possible for the market to exploit (consume) a higher amount and simultaneously increase forest storage, and thus to have both a lower current price and a lower expected price for next period. The opposite effect is associated from a reduction in the availability variable. This argument defines a forest preservation (storage) function, a schedule that dictates a direct relationship between availability and forest storage. Moreover, if current total market availability is sufficiently low, it may be the case that it is economically optimal to deplete the forest stock. This case will occur if today's current price is higher than tomorrow's expected price under no storage, the price appropriately discounted by the relevant financial interest rate.

This last case of total stock depletion is of great interest, since it underlines the possibility that market economic signals *alone* may not provide enough of an incentive to prevent a private forest investor from completely depleting available timber stocks.

The Effects of Regulation Uncertainty

I explicitly introduce regulation uncertainty into the discussion by means of a description of the future as belonging to one of two possible scenarios: one is that next period continues to be exactly like the present, no new forest regulation is in place, and the private owner of the forest is free to exploit it in a fashion that best fits its private interests. Alternatively, the future can come with a whole body of forest exploitation regulation, in the form of various norms regarding forest management and cutting patterns.

Suppose that at an arbitrary time period there is a positive probability of future forest regulation. This regulation would imply a specific restriction in the forest exploitation plan, a restriction that reduces the commercial return associated with the forest investment in future periods. Then, for any given level of total initial forest availability, the net profits from holding stocks will take values contingent on the state of the world: if next period there is a forest management restriction in place, the commercial re-

turn associated with the restricted forest stand gets reduced, because it would not be possible to exploit the forest in an unconstrained fashion. Alternatively, if no regulation is imposed, net profits are higher.

The presence of this positive probability of regulation means that, for any arbitrary initial forest availability level, and for fixed current and expected prices, the expected net return from keeping the forest one more period gets reduced, because this expected net return is a mixture of the discounted market expected price if the forest was allowed to be exploited, and the per-unit lower return that the forest would generate if there were exogenous constraints on exploitation. To compensate for this "regulation effect" on the return, the market price of forest stocks has to increase faster, in expectation, an implication that is obtained from a simple arbitrage logic: if forests are still to be preserved on time, the commercial price has to increase in order to meet the profit requirements of private owners, otherwise the private incentive to preserve the forest would not be strong enough, as compared with the return of alternative uses of the land.

This result does not rely on any kind of risk aversion assumption, but it is the consequence of a market adjustment requirement, a general statement on expected prices responding to potential profit signals.

In general, it is not only the case that expected prices are affected by the probability of regulation, but also the forest preservation decision has to respond to these changes in economic conditions. Indeed, the reduction in net expected profits that is triggered by the regulation possibility implies that the incentive to preserve the forest is lower, or equivalently, the incentive to exploit is higher, *at any level of forest initial availability.*

Specifically, the response of the forest storage schedule is as follows: an increase in the probability of regulation implies a decrease in the forest stocks function, i.e. a higher forest harvest rate. The intuition for this result is provided by the intertemporal decision making process. No matter what the initial forest stocks are, if the probability of regulation increases, then it is optimal for the forest owner to reduce the amount of forest stocks, because the expected return from holding stock is now lower, provided proper consideration is taken of the government regulation possibility, and this adjustment process will continue until a new level of arbitrage intertemporal equilibrium is achieved, for the market as a whole.

Given the economic environment, it is even possible that the individual owner decides on total commercial stock depletion, a case that seems to closely follow the Latin American native forests reality: large extensions of native forests are being "mined" as they become commercially accessible. The expected price variation incentive does not appear to be a signal strong enough to keep native forests standing.

News about the Probability of Regulation

The probability of regulation is likely to change over time, as a consequence of a variety of factors, including political pressure by both the forest industry and environmental groups. Moreover, these changes are bound to be transitory rather than permanent, as the elements that determine this probability vary over time.

The previous section considered a setting where the probability of regulation is not expected to be revised at any time in the future. Alternatively, if the probability of regulation is itself a random variable, expected profit maximization implies that the forest owner revises the storage decision every period for any given availability level, as a function of the specific realization of this random variable. This situation can for example describe a world where at any given time period the investor receives news about the probability of regulation for next period, but cannot forecast it for subsequent dates. It resembles the case of many Latin American countries, where forest owners can possibly assign a forecast for the likelihood of their forest investment being regulated during the next several years, but cannot accurately predict the value of that probability for the long run future.

In this more realistic context, the results that are obtained follow the lines of those explained in the previous section: the intuition is that news of a higher probability of regulation for next period generates a higher forest exploitation rate today, and vice versa for a lower probability of regulation. Nevertheless, this "news effect" is only transitory: forest owners will react to a higher or lower level of the probability of regulation only for the period in which that specific probability of regulation stays in place.

The problem with these risk changes is obvious: increased risk can induce complete stock depletion of the remaining exploitable standing forest, with losses in forest resources that could be biologically irreversible, as it is the case in many natural forests that are being mined and cannot be reproduced in Latin America. This effect can be produced even if the regulation risk is transitory: it may well be too late to produce a regulation to preserve a forest resource from exploitation, if this regulation comes into effect when most of the forest itself has already been depleted, precisely as a response to the anticipation of that very regulation. In this last case, reduction in future uncertainty could be ineffectively late, if most

of the forest reserve has already been cleared in response to a previous uncertain environment.

Also parallel to the previous section, there will be a faster price increase in those periods associated with a "riskier" forecast in regulation, and vice versa for those periods with a low regulation risk.

Concluding Remarks

This paper presents a pervasive problem to forest stock preservation: how regulation, and particularly its anticipation, negatively affects the forest stock decision making. This problem is studied in a simplified conceptual framework, a setting that allows concentration on the specific implications of the anticipation of forest regulation. Clearly, actual forests char-acteristics and their ownership structure are heterogeneous and therefore their management plan would be affected differently by uncertainty. Nevertheless, as long as forest harvesting decisions react to market signals, the results presented in this paper would in general apply.

The issue of regulation uncertainty is particularly relevant for countries that are politically and economically unstable, a setting that fits well many Latin American countries, where changing conditions have historically dictated dramatic revisions in forest norms and regulations, with complex implications in terms of deforestation incentives.

It is particularly disturbing that slow-growth, commercially fragile native forests in Latin America are being systematically mined as they become accessible or as the presence of commercial infrastructure allows their profitable destruction. In this case, weak economic incentives for preservation of the forest are being exacerbated by the anticipation of future forest regulation, all of which makes forest preservation a very unattractive alternative, from a private perspective.

In fact, the anticipation of forest regulation can be strong enough to dictate complete stock depletion, as a means of avoiding fixing the land use to a resource that does not provide a competitive commercial return. It is then possible that the signal of exogenous land restrictions triggers a perverse effect on forest cutting patterns, an effect that could be strong enough to actually generate the need for the imposition of such a restriction, so that regulatory signals can become "self-fulfilling" predictions.

Four implications can be obtained from the previous results: (1) an increased probability of regulation produces forest price "jumps," both expected and in terms of ex-post realizations, generating changes in the expected forest product consumer's welfare, (2) this paper offers a qualification for the usual forest preservation argument that favors direct restrictions on the land use: the imposition of strict forest management standards (as usually advocated by environmental groups) does not necessarily reduce the forest depletion rate. In particular, the structure of the forest law matters; the threat of exploitation prohibitions, if anticipated by private investors, may have a negative effect on privately owned forest lands, an effect which is not generated by forest subsidy policies. It is also relevant to note that some subsidy policies can also be ineffective in achieving a permanent increase in forest stocks. This is the case of a time-inconsistent subsidy plan: if the subsidy policy is not credible as a permanent incentive (because a global forest stock increase would reduce the public marginal incentive for conservation of the forest stock), a government commitment towards a permanent subsidy policy becomes a non-credible statement, and private forest investors, anticipating that this could be the case, would not necessarily react to a forest subsidy by increasing their forest stocks. (3) Moreover, the perverse effect on forest stocks that is discussed in this paper is also generated by *transitory* changes in the likelihood of forest regulation, if these changes are forecasted by agents (i.e., if there are "news" about the likelihood of future regulation), as private forest owners adjust their forest stock level at every time period according to the expected net return of maintaining the forest stock in time. (4) Public investment and/or subsidy in road and commercial infrastructure aggravates the problem of deforestation, particularly of vulnerable, slowly growing native forests.

Based on these effects, the following policy recommendations are proposed: (1) minimize uncertainty about the content of future forest laws, (2) provide credible signals of future positive compensation for forest preservation measures taken by private owners, and (3) assess the implications, in terms of deforestation impact, of public investments and subsidies in forest road construction, transport facilities, and commercial infrastructure.

The model presented in this paper can be used to study the implications of specific regulation and subsidy instruments (including size and timing of the policy instrument), in terms of deforestation. This next step will involve the uncovering of the distinctive effects that are to be expected from distinct particular restrictions and incentives.

In addition, the model can be used to compare forest exploitation rates associated with different species or different forest locations, each having a distinct natural growth rate and subject to a (possibly) different probability of regulation.

REFERENCES

Binswanger, Hans P. 1989. Brazilian policies that encourage deforestation in the Amazon. Working paper no. 16, Environment Department. Washington, D.C.: The World Bank.

Bobenrieth, Eugenio S. 1996. A model of forest stocks in Latin America. Berkeley, CA: Department of Agricultural and Resource Economics, University of California.

Deaton, Angus, and Guy Laroque. 1992. On the behaviour of commodity prices. *Review of Economic Studies* 59: 1–23.

Faustmann, Martin. 1849. Calculation of the value which forest land and immature stands possess for gorestry. In Martin Faustmann and the evolution of discounted cash flow (1968), edited by M. Gane. Forestry Institute Paper, no. 42. Oxford: Commonwealth Forestry Institute: 27–55.

Feder, Gershon, Tongroj Onchan, Yongyuth Chalamwong, and Chira Hongladarom. 1988. *Land Ownership Security, Farm Productivity and Land Policies in Thailand.* Baltimore, MD: Johns Hopkins University Press.

Food and Agriculture Organization of the United Nations. 1993. Forest Resources Assessment 1990: Tropical Countries. Forestry Paper, no. 112. Rome: Food and Agriculture Organization of the United Nations.

Fortmann, Louise, and James Ridell. 1985. *Trees and Tenure.* Nairobi*:* International Council for Research in Agroforestry.

Hartman, Richard. 1976. The harvesting decision: When the standing forest has value. *Economic Inquiry* 14, no. 1: 52–58.

Hyde, William F. 1984. Timber valuation. In *Valuation of Wildland Resource Benefits,* edited by G. L. Peterson and A. Randall. Boulder, CO: Westview Press: 131–41.

Hyde, William F., David H. Newman, and Roger Sedjo. 1991. Forest economics and policy analysis. World Bank Discussion Paper 134. Washington, D.C.: The World Bank.

Instituto Forestal, Division Estudios Economicos y Medio Ambiente. 1995. *Estadisticas Forestales 1994.* Boletin Estadistico, no. 40. Santiago, Chile.

Lofgren, Karl-Gustaf. 1983. The Faustmann–Ohlin theorem: A historical note. *History of Political Economy* 15, no. 2: 261–64.

Mahar, Dennis J. 1989. *Government policies and deforestation in Brazil's Amazon region.* Washington, D.C.: The World Bank.

Mitra, Tapan, and Henry Y. Wan, Jr. 1986. On the Faustmann solution to the forest management problem. *Journal of Economic Theory* 40: 229–49.

Niklitschek, Mario, and Eugenio S. A. Bobenrieth. 1992. Incentivos Economicos para una Explotacion Eficiente del Bosque. *Cuadernos de Economia* 88. Pontificia Universidad Catolica de Chile.

Samuelson, Paul A. 1976. Economics of forestry in an evolving society. *Economic Inquiry* 14: 466–92.

Spears, John. 1988. Containing tropical deforestation: A review of priority areas for technological and policy research. World Bank Environment Department Working Paper, no. 10. Washington, D.C.: The World Bank.

Williams, Jeffrey C., and Brian D. Wright. 1991. *Storage and commodity markets.* Cambridge University Press.

World Resources Institute, in collaboration with the United Nations Environment Programme and the United Nations Development Programme. 1994. *World Resources 1994–95.*

IMPROVING NATURAL RESOURCE MANAGEMENT REGIMES

LESSONS FROM UNITED STATES–REPUBLIC OF KOREA POLLOCK NEGOTIATIONS

Brian Potter

Introduction

While the recently negotiated Bering Sea Pollock Convention will help the half-billion-dollar U.S. pollock industry, gains from international management of marine fisheries can be improved on by scheduling entry according to nations' cost and revenue functions. An example from the Bering Sea pollock fishery shows that low-cost, high-revenue fleets, such as South Korea, could profitably harvest their share of the fishery after the United States had enjoyed cost-saving exclusive access to the pollock stocks during the first part of the year. By trading valuable access to the U.S. coastal zone in exchange for foreign cooperation in international waters, U.S. policymakers can both offer an advantage to the internationally competitive pollock industry as well as pursue U.S. environmental policy objectives relating to marine mammals and bycatch. This article describes the history of international management of fish stocks important to U.S. fishermen, uses economic theory and real data to show the possibility of a trade between the United States and South Korea, compares the net result of three policy options for the pollock fishery, and weighs the obstacles to implementation of a stepwise agreement.

Only a decade ago, the academic consensus maintained that attempts at common property management were doomed to failure. Work done several decades earlier by biologists and economists[1] offered convincing reasoning on the inevitable "tragedy" of commons exploitation, a line of inquiry that set the ensuing research agenda. After pathbreaking work by Elinor Ostrom[2] that specified institutional conditions under which access to resources could be

[1] Seminal works on common property resources include Shaefer (1954) and Gordon (1954).
[2] Ostrom (1990).

controlled, scholars put their pessimism aside and investigated institutions that effectively managed resources held jointly by members of a community. In essence, the problems popularly associated with the commons were found only in a subset of cases, those where access to the benefit stream of the resource remained unregulated. Research in this vein by the international relations community came to maturity with several publications[3] that offered clues as to when sovereign countries would be able to create regimes and agreements to realize joint gains in international resource management. This paper represents continued effort in that direction and aims to demonstrate the advantages of institutionalized cooperation in international resource management over the possible results of unilateral management attempts.

The above claims are presented through an example of negotiations between the United States and the Republic of Korea (ROK) concerning fishing access to North Pacific pollock. The principle North American groundfish stock, pollock is retailed domestically and abroad in a number of forms. In the 1990s, U.S. fishermen have landed more tons of pollock than any other type of fish and pollock has accounted for roughly a third of total U.S. catch. In terms of value, the pollock fishery is the fourth largest revenue earner of all U.S. fisheries, with an ex-vessel (prior to processing) value of $313 million in 1991.[4] Fishing companies and their employees from Seattle, Washington, and the state of Alaska depend on the health of the pollock stocks as their prime resource.

U.S. firms, however, share their interest in North Pacific pollock with foreign rivals. Pollock stocks migrate out of the two hundred-mile U.S. fishery jurisdiction where they are subject to unregulated catch by other countries, mainly Japan, Poland, the People's Republic of China, and the ROK. To a varying extent, these countries explored and developed inside the U.S. Exclusive Economic Zone (EEZ) pollock grounds to supply their own markets at a time when U.S. fishermen were uninterested in the high-volume, low-priced groundfish. Their displacement by U.S. fishermen in the late 1980s caused resentment of U.S. fisheries jurisdiction and increased effort at high seas pollock harvests.

Pollock do not swim alone in this regard but instead join a list of fish stocks that migrate across national jurisdiction. Many of the world's most commercially important fish stocks, such as shrimp and tuna, nominally fall under coastal state management yet are open to harvesting beyond the jurisdiction of the entrusted state. Last year, disputes over North Atlantic groundfish led to the much-publicized "turbot wars" where Canadian gunships seized one Spanish trawler on the high seas and threatened others. This international common property problem actually encompasses two types of settings. First, some transboundary fish stocks are shared by two (or more) countries yet do not enter international waters. A second category of fisheries, straddling and highly migratory stocks, are found both within national jurisdictions and on the anarchic high seas. This paper will concentrate on the latter problem although implications for transboundary resources also arise. Thus, the conflict over pollock represents a large and important class of international disputes over access to shared fish stocks.

The potential for commons destruction provides the primary motivation behind the demand for international regimes to manage internationally shared fish stocks. The pain and dislocation to fishermen resulting from a depleted resource should encourage policymakers to direct their efforts at regime formation. Cooperative fishery management among nations can lower costs and raise revenues to participating fishing firms, thereby providing direct benefits to constituents. The potential for success in international fishery regime formation looks promising since bargaining can identify simple focal point solutions, viable enforcement mechanisms, and uncertainty regarding future biological productivity.[5] Furthermore, the potential for integrative bargaining is yet unexplored, as the application below suggests.

After describing past and current efforts to manage pollock and other international fish stocks, the paper identifies the role of costs and revenues in determining preferences in common property management. This framework is applied to a simulation of U.S.–ROK negotiations concerning Bering Sea pollock to show the possibility of an integrative solution, termed stepwise harvesting. The benefits of stepwise regulation are compared to other policy alternatives for pollock management. After weighing obstacles to implementation, the paper concludes with an assessment of the potential of a stepwise approach to the management of other international fisheries.

The Bering Sea Pollock Convention and UN Straddling Stock Conferences

As more fishing capacity was directed to the pollock derby in the late 1980s and early 1990s, two sets of negotiations offered the potential of institutionalized international management. The National Marine Fisheries Service (NMFS) and the Department of State joined their Russian counterparts in urging a management accord that would guarantee a larger

[3] Young (1989a); Haas, Keohane, and Levy (1993).

[4] Herrick, et al. (1994).

[5] Young (1989b).

share of the pollock resource for coastal states and prohibit further entry. At roughly the same time, scores of nations attempted to tie up loose ends of the 1982 Law of the Sea Treaty by negotiating an agreement on highly migratory and straddling fish stocks.

Ongoing talks within the United Nations to resolve straddling and highly migratory stock ownership offered for ratification a final Agreement[6] addressing management and enforcement issues. In general, the Agreement calls for coastal states and concerned fishing nations to enter into regional or subregional agreements to manage straddling and highly migratory fish stocks. Where no such agreements exist, parties should work towards their creation. Responsibility for enforcement of management measures lies with the home or flag state, although substantive powers are reserved for the coastal state. Coastal states can board and search vessels from other nations as well as "take measures, in accordance with international law, to promote the effectiveness of subregional, regional, and global conservation and management measures." Countries that are not members of the regional fishing institution may not allow their nationals to fish in the concerned waters. Thus, while the Agreement stops short of granting coastal state jurisdiction over straddling resources, it does strengthen and provide for international regimes as well as expanding coastal state enforcement powers.

The third negotiating session produced a "Draft Agreement" that was widely endorsed by most parties but the Draft excluded some of the thornier issues in hopes that informal consultations might better lead to agreement. In particular, the extended enforcement powers of coastal states raised objections from distant water fishing nations. When a group of coastal states blocked a weakening of the enforcement provisions, several signers of the Draft chose not to ratify the final Agreement. Their absence detracts from the *de facto* but not *de jure* legitimacy of the treaty. The Agreement is open to signing through 1996 and already has the required thirty signatories to come into force.

Those skeptical that the Agreement will have an impact have noted that the enforcement powers and limits are not clearly defined and some of the most important fishing nations have not signed. Nonetheless, the Agreement signals the direction of development of international law if it does not specify what measures are to be allowed. Straddling stock disputes will continue while coastal states, distant-water-fishing nations and international jurists implement the Agreement's provisions.

Moving from the set of global negotiations among over one hundred countries to the six-country pollock talks, we find a more specific agreement. While the Soviets and Americans worked their respective economic zones, other fishermen responded to decreasing foreign allocations of the two host countries by increasing their efforts in international waters. Although most of the Bering Sea comes under Russian or American jurisdiction, two areas in the middle lie beyond the two hundred-mile mark from both continents. The "Peanut Hole" and the "Donut Hole" are completely encompassed by the two territorial seas yet access to these areas is open to third parties as coastal states cannot restrict freedom of navigation beyond the twelve-mile limit. Controversy about catches of American-bound pollock in the Donut Hole exceeded the Russians' clamor over the fishing for Asian pollock in the Peanut Hole. Japanese catches of U.S. pollock in the Donut Hole increased from 135,000 metric tons (MT) in 1985 to 1,300,000 MT in 1987.[7] Other countries responded similarly: while five vessels fished the Donut Hole in 1982, eight years later 194 vessels harvested Donut Hole pollock.[8] U.S. fishery managers estimated losses of $650 million a year to U.S. harvesters, processors, and dealers.[9]

In consultation with the Soviet Union, the United States invited all states participating in the fishery to a series of conferences in Washington and Tokyo.[10] The Japanese welcomed the conference as a means to solve the dispute before the pollock resource became decimated. Indeed, Tokyo had already been regulating its fishermen with a limited entry program when the onslaught of newcomers threatened the profitability of Japanese operations.[11] However, support for a possible agreement was limited to three states and the threat of further entry by other countries remained.

Fishing prospects in the Donut Hole worsened to such an extent that all involved nations agreed to a moratorium on high seas pollock fishing for the 1993 calendar year. Although more plentiful in coastal waters, pollock had become scarce enough in the Donut Hole to make further fishing prohibitively costly. The moratorium would be extended for the next three seasons as conditions failed to improve. Asked about the prospects of 1997 Donut Hole pollock fishing, the head biologist of the Bering Sea Plan Team replied

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[6] Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of December 10, 1982, Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. The document and notes on the negotiations can be found on the Linkages Homepage, <http://www.iisd.ca/linkages/fish.html>

[7] Miles and Burke (1989).

[8] Hayashi (1991), pp. 343–64, 352–54.

[9] Plugging the Donut Hole (1988).

[10] The 1991 Conference on the Conservation and Management of the Living Marine Resources of the Central Bering Sea.

[11] Hayashi (1991), p 356.

"Zero to nil."[12] The pollock derby of the late 1980s and early 1990s decimated the fishery to such an extent that the stock has yet to recover to commercially viable population levels.

The prospect of stock collapse, along with diplomatic nudges by the United States, Japan, and Russia, renewed the efforts of Poland, China, and Korea to conclude an agreement. After nine international conferences, the North Pacific Pollock Convention[13] was ratified in the summer of 1994 by all six parties. The Convention provides for Annual Conferences of the Parties to set total allowable catch rates (TACs) as well as individual national quotas (INQs). The division of spoils is rumored to allocate 80 percent of the resource to Russia and the United States, with the remainder to be split up among the four other states.[14] The Pollock Convention is stronger than other international fishing agreements in two ways. First, countries cannot "opt out" of selective regulations as they can in, say, the North Atlantic Fisheries Organization (NAFO). Selective policy adherence in NAFO not only prevented enforcement, but coastal countries tempered their management proposals in an attempt to maintain the participation of recalcitrant states. Second, in the event that agreements cannot be reached, the Pollock Convention mandates a return to an unsavory status quo decision mechanism. The TAC is to be set by the United States NMFS if the six parties do not agree on a total catch level. If states cannot divide the TAC into INQs, the fallback policy is an open access fish derby to be closed when total catches approach the TAC.[15] Finally, the agreement provides for international enforcement as it allows the boarding and search of vessels by officials of the other member states. The Convention precludes the ability of states to set their own fishing policies outside the workings of the international agreement.

While the Pollock Convention looks good on paper, it has yet to be put to the test. Poor stock conditions made Donut Hole harvesting prohibitively costly and all countries agreed to a moratorium on high seas fishing for three, going on four, consecutive years. When conditions allow the fishery to reopen, some countries may have an interest in delaying the implementation of national quotas. The fish derby that would follow a failure to specify INQs might favor the lower-cost distant water harvesters such as Korea, China, and Poland. If they refused to bargain for INQs in good faith, Russia and the United States might abandon the accord in favor of more efficient unilateral or bilateral action.

The effectiveness and legitimacy of the UN Agreement and the Pollock Convention are not secure and implementation of the accords is needed to work out their details. The poor fishing prospects of the past three years, rather than international negotiations have served to protect pollock stocks. The remainder of this paper will argue for the benefits to be gained by coastal state adherence to the Pollock Convention. In addition, regulation is proposed which would improve the efficiency of the agreement for all participating parties.

It is because of South Korea's historic participation in the pollock fishery, its role as a distant water fishing nation and its reluctance to sign the final UN Agreement that I've chosen to model the ROK in the negotiation process. The selection of Korea as an example does not come from misconstrued stereotypes of distant-water fishing nations as poor conservationists at best and marauding pirates of fisheries at worst. In the pollock and straddling stock negotiations in particular and UNCLOS negotiations in general, the South Korean government has been constructive and compromising. Indeed, the efforts at fishery conservation and management by the Korean National Fisheries Administration have produced an impressive and rarely equalled supply of fisheries data that allows this study to continue. The application of Korean interests to possible negotiations is not to imply any history of intransigence in its straddling stock management.

Differentiating Interests in Stock Management

In commons exploitation, one trait giving an actor an edge in destructive competition is the ability to withstand drops in resource availability. Changes in stock size effect both revenues and costs, as shown by a well-known model of commons exploitation.[16]

The instantaneous growth rate of a fish stock [G(b)] with quadratic biological replenishment is a function of the natural carrying capacity of the stock (~~b~~), the present population (b), and an intrinsic growth rate for the particular stock in question (B):

$$G(b) = Bb(\text{~~b~~} - b) = B(-b_2 + \text{~~b~~}\, b).$$

Sustainable harvests occur by setting the catch (x) equal to the growth rate

$$x = G(b) = Bb(\text{~~b~~} - b)$$

so that the amount of fish caught each season does not detract from the stock's ability to replenish itself.

[12] Communication with Dr. Low Lee Low, head of the Bering Sea Plan Team at the Alaska Fisheries Science Center in Seattle, Washington, June 6, 1996.

[13] Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea.

[14] Dunlap (1995).

[15] Details of the agreement are given in Dunlap (1995).

[16] For example, see Neher (1990), chapter one.

From the fishermen's perspective, revenues from steady-state fishing equal the catch multiplied by bayside (or ex-vessel) price (p):

$$TR = px = p[Bb(\bar{b} - b)]$$

Harvesting costs are a function of the difference between maximum and actual stock population ($\bar{b} - b$), the intrinsic growth potential (B), the technological efficiency of fishing gear and talent (A) and a wage (w):

$$TC = w[(B/A)(\bar{b} - b)]$$

To maximize profits by controlling catch, the resource manager seeks to increase the difference between costs and revenues:

$$\text{Max } P = TR - TC = p[Bb(\bar{b} - b)] - w[(B/A)(\bar{b} - b)]$$

implying that the stock should be managed at a population of

$$b^* = \bar{b}/2 + 1/2(w/p)1/A$$

to make the most of the resource in a sustainable manner. Management at this optimal population level maximizes profit. If two sets of fishermen work the same stock, their optimal values of b*, the economically ideal population of a given stock, depend on wages, bayside prices, and the technological efficiency of the crew and vessel. Thus, the difference in their preferred management policies reduces to

$$b_1^* - b_2^* = 1/2(w_1/p_1)1/A_1 - 1/2(w_2/p_2)1/A_2.$$

Different cost and revenue functions lead to dissimilar ideal management strategies.

Preferences for stock size vary according to unit costs, fish prices, and the efficiency of catching gear. More abundant stocks (higher levels of b*) reduce costs yet decrease the amount available for harvest. Fishing firms facing high costs will be more concerned with cutting expenses than maximizing catch. As the price of labor or other inputs (w) drops, concerns over cutting costs decrease and fishermen prefer higher catch rates. Similarly, if technology and talents become more efficient, fishermen favor increased harvest rates. Higher harvesting costs stem from less efficient gear, generating a preference for decreased catches. However, when bayside prices drop, cost considerations again rise to the forefront, implying a preference for thicker stocks and limited current harvests. Higher product prices diminish cost-cutting concerns and lead to a preference for increased catch, or a lower sustained population.

The impact of different cost and revenue functions for ideal stock size is shown geometrically in figures one and two. The horizontal axis defines the size of the fish stock (larger to the left) and the amount of fishing effort for one season (larger to the right). The growth rate of the natural asset with respect to stock size increases until the point of maximum sustainable yield (MSY) and thereafter declines but is still positive. In both figures, total sustainable revenue is a function of a set price and amount of sustainable catch, measured on the vertical axis. Costs steadily increase as the fishery receives more fishing effort. Profits are highest at the optimal sustainable yield (OY) point which defines the population level that offers the greatest distance between total revenues and total costs. Lower costs (shown in Figure 1) or higher bayside prices (shown in Figure 2) force a country's OY point closer to the MSY mark, implying that the country could profitably fish longer in the season than its rival.

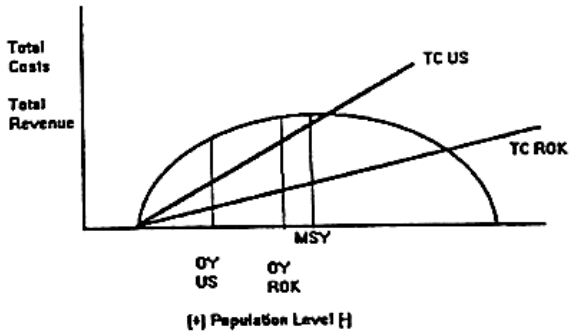

Figure 1: Effects of Varying Costs on Optimal Population

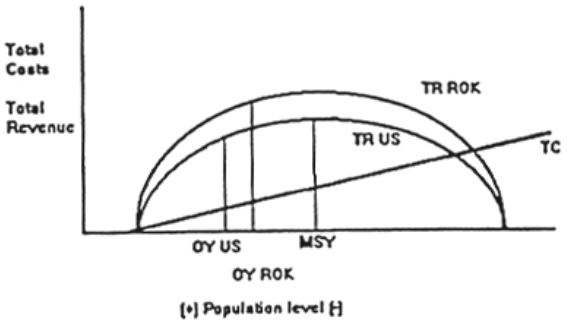

Figure 2: Effects of Different Bayside Price on Optimal Population

Implications for straddling stock policies arise from the conclusions drawn above. Incorporating crossnational differences in bayside prices, the cost of inputs and technological efficiency, political–economic models can predict how much tolerance fishermen from a given country have for drops in stock levels. National fleets facing lower input costs, receiving higher dockside prices or possessing greater technological efficiency can withstand longer

international competition that depletes a straddling stock.

Estimating Optimal Stock Levels for the U.S. and ROK Fleets

Our simplified pollock fishery involves only two participants who differ in only three variables: bayside price, labor cost, and the technological efficiency of fishing gear. The natural carrying capacity and the intrinsic growth rate of the stock can be assumed constant across the two actors since they are both harvesting the same stock. Concerns of public assistance and resource objectives will be introduced later, as these factors are difficult to quantify. The simulation describes what population level leads to optimal management from the perspective of each country.

The maximum sustainable yield of the pollock fishery approaches two million metric tons. That is, biologists feel that the stock can completely rejuvenate to its previous population if fishermen annually catch no more than the said amount. The catch amount that maximizes profit (OY), however, is less and varies according to fish prices, the cost of inputs, and technological efficiency. The optimal harvests for U.S. fishermen in the late 1980s and early 1990s, as established by the NMFS, ranged between 1.15 and 1.5 million metric tons. These figures and their distribution among the various U.S. fisheries sectors result from complicated[17] and non-robust calculations that use non-economic factors (i.e., social dislocation) in the highly contested optimal yield estimates.

To control for natural stock volatility, very rough calculations of the second term in optimal population, the influence of input prices, product price, and catching efficiency, 1/2(w/p)1/A, were made for Korean and U.S. vessels from the years 1985–1991. These figures, reported in Table 1, are based only on price levels, wages and technological efficiency. Data sources can be found in the appendix. Unlike actual U.S. optimal yield estimates, no attempt has been taken here on account for the impact of yield changes on either society as a whole (i.e., consumer surplus, opportunity cost of dislocated fishermen) and information on public subsidies were not available.

The calculations assumed a pollock catch of two tons per hour, with twenty Korean or ten U.S. crewmembers working. In general, Korean optimal yields are greater (the stock population can be lower) than those for U.S. fishermen, reflecting the lower cost of inputs and higher product prices confronting the Korean fishing industry.

Year	ROK	United States
1985	1.855	253.111
1986	1.746	196.515
1987	1.542	123.623
1988	1.864	98.292
1989	2.079	77.501
1990	1.910	60.461
1991	1.968	55.281

Table 1: Influence of Input Prices, Product Price, and Catching Efficiency on Optimal Population for the United States and ROK, 1985–1991 (in metric tons)

The differences between optimal stock levels for the United States and ROK are reported in Table 2. Note that, in many instances, the difference is greater than the potential 5 (57,500–75,000 MT) percent of the stock the ROK might receive and often comes close to 20 (230,000–300,000 MT) percent of the stock that would be allocated to all four non-coastal countries under the Pollock Convention. The Korean fleet could profitably catch its share of pollock after U.S. and Russian fishermen harvested their economically justified quotas and had left the fishery for the year.

Year	Yield
1985	251.25
1986	194.76
1987	122.08
1988	96.42
1989	75.41
1990	58.55
1991	53.31

Table 2: Differences between U.S. and Korean Optimal Yields (in metric tons)

Evaluating Policy Alternatives for Pollock Management

As noted above, it is unclear how well the Pollock Convention will work. If the U.S. fishing industry feels the accord is ineffectual, the State Department faces several options for pollock management. Abandoning the Convention would force participants to return to the unregulated fish derby that they have sought to avoid for the past several years. Adherence to the accord in its present form offers several advantages over the international open-access fishery. Perhaps the option most beneficial to all parties would be to develop a system of sequential or stepwise harvest quotas among the current six states. A listing of the costs and benefits of each option follows.

[17] For an illustration of the web of details and procedures in estimating and allocating optimal yield in the pollock fishery, see Milon (1993).

The lack of agreement in the early 1980s and late 1990s forced costs on first the U.S. industry and later on all fishermen dependent on pollock. U.S. firms saw an increasing share of the resource nominally under their control being caught by rival fishing companies in international waters. Without the international agreement, pollock stocks were managed by area regulation, one of the least useful types of fishery management options. Coastal fishermen harvested the stock in their waters while distant water operations were limited to the high seas. Enforcement on the fringes of U.S. jurisdiction proved incredibly costly and difficult: Coast Guard patrol planes spent most of their fuel in transit, leaving little time to search for or track suspected violators of U.S. fishery jurisdiction.

Eventually, the Donut Hole fishery closed for three consecutive seasons as the participating nations had depleted the biomass to a degree where it became uneconomical to fish. The Donut Hole devastation imposed negative externalities on those fishing closer to shore as well.

In sum, the condition of the pollock fishery without an international agreement follows the pathologies of the common property model. Without a means to develop and enforce limits on catch, the participating fishermen were trapped in a tragedy of the commons. The ensuing economic destruction of the resource might have been the factor strengthening support for an agreement.

The conclusion of the agreement promised coordinated stock management to prevent such a tragedy in the future, offering benefits to all fishermen. Data collection, verified by neutral observers, is required. This information is used in setting the TAC and enforcing the INQs. Just as important, the Convention and the negotiations leading to it signaled to outsiders that entry of additional fishing fleets would be strongly resisted. Without limits on further entry, any gains made under the agreement would merely tempt additional fleets to target pollock stocks. In luring the non-coastal countries into an agreement, Russia and the United States ceded part of the resource in return for coordinated stock management which increases returns to all participants. The Convention could fulfill its stated goals of gathering biological data, restoring stocks, and creating "an international regime for conservation, management and optimum utilization of pollock resources" in the Donut Hole.[18]

The primary weakness of the Convention, however, is the continued emphasis on national jurisdiction to manage an international resource. Relying purely on the will of foreign elected officials to effectively enforce the accord leaves it vulnerable to political intrigue and cabal. Coastal states could exercise more control by offering their own rewards to foreign fleets in exchange for cooperation regarding straddling stock management. Gains can be realized by all parties in exchanging access within coastal EEZs for delayed harvests by fleets facing lower input costs and higher product prices. The examples above of optimal biomass levels showed that most, if not all, of the Korean catch could take place after stocks had been harvested to a level considered uneconomical for U.S. firms. Due to higher harvesting costs and lower product prices, the U.S. fleet needs a thicker stock for profitable fishing. What would be the costs and benefits to the United States and Korea of trading access inside the United States EEZ for delayed Korean participation?

For the Korean fleet, access to U.S. waters offers more fertile fishing prospects as well as improved safety. Korean fishermen work the Donut Hole not because it is their first choice of fishing grounds but instead because that is where they are allowed to fish. Fishing activity in the Donut Hole increased only as foreign fleets were displaced from their preferred areas within the U.S. EEZ. Catch rates are generally better closer to shore than in the high seas.[19] In addition to improved catch rates, access within the U.S. EEZ offers improved safety to Korean fishermen. Currently, more than a dozen U.S. fishermen a year lose their lives fishing the unforgiving waters off Alaska. The number of fatalities has roughly halved in the last three years thanks to improved Coast Guard response time and regulations. No such services are available in the rougher waters of the Donut Hole. Access inside the U.S. EEZ offers to foreign fishermen improved catch rates and life-saving services as well as facilities for transshipment and refueling.

By trading such access for a delayed Korean entry, the U.S. industry gains a fishing season without competition from rivals on the seas or in markets. U.S. trawlers would enjoy cost-saving thicker stocks, a factor the American Factory Trawlers Association has pushed for in North Pacific Fishery Council debates. For the U.S. fishing industry, these benefits come at little or no cost: in most instances, Korean harvests can take place after the U.S. vessels have left the fishery for the year.

A stepwise agreement fulfills other U.S. policy objectives as well. Foreign vessels operating inside the EEZ would have to follow U.S. regulations concerning bycatch retention and marine mammal protection, environmental concerns enjoying widespread domestic support. While such measures present additional costs to the Korean fishing industry, these expenses are over-shadowed by unavoidable fuel and labor costs. EEZ access may also encourage foreign direct investment in the shoreside U.S. fishing indus-

[18] Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea, Article II.

[19] A survey of yields per hour is given in Bulatov and Sobolevskii (1991).

try, strengthening its competitiveness in an increasingly global market for fish products.

Increased search costs by the Korean industry may follow. Trawlable schools of fish will be more difficult to locate after the U.S. industry has taken its share. Deciding to what extent this factor disadvantages foreign fishermen is an empirical matter. Existing data may be used in estimating increased search expense. Negotiators may take into account other benefits gained under a stepwise agreement by foreign fleets or may adjust the INQ to accommodate the possible increased search costs.

In summary, the existing pollock agreement offers several benefits over the unregulated international fish derby:

- coordinated management of pollock stocks to prevent future commons tragedies,
- reliable data collection,
- threats against entry by other nations, and
- shifting the enforcement burden from the U.S. government to fishing firms.

The agreement can be improved on by granting access within the U.S. EEZ in exchange for a delayed foreign entry. In addition to the benefits above, this further measure would:

- allow U.S. trawlers to fish in United States and international waters without competition,
- provide more fertile fishing prospects to foreign vessels,
- provide safety, refueling, and transshipment opportunities to foreign fleets, and
- allow pursuance of other U.S. policy objectives (i.e., bycatch, marine mammals).

The benefits offered by the stepwise proposal to both U.S. and Korean fishermen probably outweigh the possible increased search costs of the latter, providing an opportunity to improve fishing opportunities to both parties.

The stepwise arrangement is more plausible where host countries encounter higher input costs and lower product prices. Where national fleets show little difference in such variables, the opportunities for beneficial regime change are less likely. Similarly, when the coastal state industry faces lower costs and higher bayside prices (as might be the case for Korean access to the Russian EEZ), a stepwise agreement is not plausible.

Obstacles to a Stepwise Agreement

While trading a delayed entry in exchange for coastal access or other side payments may enlarge the core for agreement, there is no guarantee that the participants could agree on the terms of such a trade. The participating nations are not unitary actors looking to maximize fishing profits. Instead, each government represents a range of interest groups and must consider the implications of pollock negotiations for other policy areas. Four potential obstacles to implementing a stepwise agreement include equity considerations of DWF-nation consumers, implications of foreign access for U.S. politics, changes in the share amounts of an international agreement, and the possibility of third entry.

Delayed entry could prove to be an equitably unpalatable alternative for distant-water fishing nations. The net result may be to institutionalize the higher consumer burden and/or lower wages found in nations with distant-water fleets. As morally deficient such a policy might be, it is unlikely to arouse strong political protest in distant-water states. Prices and wages are not likely to see much change under the swap, and thus may arouse little protest. Most types of consumers exemplify collective action problems and would not be expected to organize politically against the regime change. Thus while the burden imposed on DWF-nation consumers may be objectionable, in practice it is unlikely to raise a political obstacle to a stepwise agreement.

A second hurdle to the implementation of a stepwise agreement stems from the threat to parts of the U.S. fishing industry posed by opening up trade in fishing services. The "Americanization" of U.S. marine resources produced heated political battles, ultimately won by those opposed to joint ventures and other benefits offered by foreign fleets. Divisions in the U.S. industry may make for difficult policy change. Is the idea of re-allowing foreign access too heretical for discussion?

The proposed swap benefits some groups in the U.S. fishing industry and harms others. Large pollock trawlers, mostly from Seattle but with an increasing Alaskan presence, gain the most from delayed distant-water fleet entry. On the other hand, the resurgence of foreign fishing near coastal waters could threaten Alaskan fishermen with smaller craft who do not enjoy the mobility of the large trawlers. This group may be unwilling to endure increased crowding and catch externalities on behalf of their historical rivals from Seattle. Additionally, Alaskan fishermen with smaller craft have opposed Seattle interests in implementing domestic transferable fishing quotas, a policy debate with obvious parallels to the stepwise agreement. While other fishing and environmental interests may hold opinions on the swap, the political battle would be waged by two camps: factory trawlers and Alaskan inshore fishermen.

Two powerful organizations, whose members are distinguished by size and state, voice their policy preferences to Council members and federal legisla-

tors. The American Factory Trawlers Association began in 1985 to coordinate the policy efforts of four Seattle firms. Membership has grown and includes all Bering Sea factory trawlers. An Alaskan lobbying group, United Catcher Boats, is gaining strength in its fight against the considerable Seattle role in Alaskan resources, seen as possibly perpetuated by the proposed individual fishing quotas (IFQs). Alaskan senators in 1996 delayed reauthorization of national fishing policy, the Magnuson Act, until some brakes on IFQs were adopted.

In this battle, Alaskans maintain an edge in voting Council seats, seven to Washington's four,[20] yet interests may divide along economic more than state-specific lines. A majority of Council members come from capital-intensive, internationally-oriented harvesting and processing firms. Smaller, locally-oriented harvesters, those most likely to suffer crowding effects, do not find many of their representatives appointed to the Council. Collective action problems are especially evident in the fishing industry given the diffuse gains available from fishery policy change and the mobility of fishermen. While inshore fishermen have worked hard to organize their interests, the fewer and more leveraged offshore trawling firms have held a stronger political voice among legislators and Councilmembers.

The intensity of such a dispute would follow the details of foreign access. If DWFs were granted access to the Bering Sea instead of the Gulf of Alaska, the prospect of foreign crowding externalities is severely diminished. Many of the inshore firms work the Gulf, close to processing plants and port facilities. On the other hand, the pollock stock migrates towards U.S. waters near Bogoslof Island in the Bering Sea. Thus, the location of foreign access may help to diffuse the potential conflict between the offshore trawlers benefiting from the swap and inshore fishermen concerned about crowding externalities.

Third, how sensitive are the gains from the swap to the division of pollock among the six participants? The rumor of a 20:80 split represents one end of the spectrum of allocation possibilities. It would be difficult to explain why the distant-water states would accept a smaller allocation. On the other end of the range of possibilities, the principle of equitable distribution in international affairs would render 17 percent of the share to each of the six.

One might expect that the final division would favor the two coastal states. Both the United States and Russia have led the push for a pollock regime and they hold property rights to that part of the stock caught in their EEZs. Several of the pollock rivals might find precedent in the 1911 Fur Seal Treaty concluded by the United States, Canada, Russia, and Japan.[21] At the turn of the century, private interests in all four countries hunted, with increasing and alarming efficiency, Bering Sea seals for the London fur market. While the seals rested and bred on islands owned by three of the claimants, the pinnipeds' search for food led them into international waters where pelagic hunters, principally Canadian, harvested them. The treaty entrusted harvesting rights to the nation in ownership of the islands, who then distributed a fixed percentage of the catch or revenues with other states (this arrangement is described in Table 3). The 10 to 15 percent share of the seal treaty might set precedent, or at least a lower bound, for the DWF shares under the Pollock Convention.

Proprietary nation	Shares to others
United States (Pribilof Islands)	15% to Canada
	15% to Japan
Russia (Commander Islands)	15% to Canada
	15% to Japan
Japan (Robben Islands)	10% to Canada
	10% to Russia
	10% to United States

Table 3: Sharing under the 1911 Fur Seal Treaty

Opportunities for increasing the bargaining core increase as the division of resource becomes more equitable. As the pollock share of the higher cost harvester decreases, its incentive to enter the fishery first increases. Faced with a drastically reduced quota, the advantage of early entry becomes more important to low revenue–high cost countries like the United States. Moreover, as more equitable shares force an earlier exit of United States fishermen, the remaining five actors could schedule entry into the pollock fishery according to their respective profit functions. The feasibility of the stepwise agreement increases as the DWF share increases towards equity from the 5 percent each share assumed in the example.

Finally, can the six prevent third entry? If returned to a commercially viable status, the pollock fishery may attract the attention of other distant-water fishing nations. Some of the current participants may abandon international cooperation if increased entry cuts into already-thin quotas. Both the Pollock Convention and the UN Agreement call for acceptance of new members into the international management regime. In theory, efforts to improve resource use are doomed to failure by their success: a better managed fishery only attracts more DWFs, which must be accommodated into the regime.

On the other hand, the principal parties represent the strongest forces in both the fishing industry and in Arctic policy. Japan commands the most important market for marine fish products globally. The large U.S. market and growing Chinese markets are not far

[20] Currently, three voting members of the North Pacific Fishery Management Council are from Washington and one is from Oregon.

[21] This discussion of the Fur Seal Treaty is informed by Busch (1985).

behind. Any Arctic agreement strongly supported by both the United States and Russia, such as those in the past governing the harvest of seals or polar bears, would seem to have a bright future. The six current participants could use their global and industry influence to discourage the entry of other DWFs or vessels from flag-of-convenience states.

A larger threat to international resource management comes from defection among the six participating nations. American fishermen have raised complaints that some countries conduct illegal trawling just inside the U.S. EEZ and that the Russian government has been overenthusiastic in licensing access to foreign pollock trawlers in the Western Bering Sea. Despite strict management measures in the United States' zone and a Donut Hole moratorium, overfishing in the Russian EEZ could cause disaster for all pollock fishermen. In an effort to prove their allegations, the American Factory Trawlers Association raised $150,000 to help charter an urgent hydroacoustic study to assess the 1997 pollock stock. If Russian overfishing is detected, the Americans plan to "press for restrictions on the Russians."[22] The success in solving the conflict may be a prediction of the future for international management of North Pacific resources.

In sum, the improved agreement faces some obstacles, but none are fatal. Equity considerations in DWF states may be distasteful yet would fail to produce charged debate. A potential political battle among U.S. winners and losers could be avoided by limiting foreign access to the Bering Sea. Changes in the division of the resource actually may make a time-for-access swap more feasible. Finally, the exercise of power by the six participants in related areas may be enough to prevent entry by other fishing nations. Alleged mismanagement of pollock outside the Donut Hole violates the agreement's intent yet might be addressed in international forums. Each impediment to implementation carries with it pragmatic alternatives.

Recognizing National Differences in Designing International Fishing Agreements

International fishing accords often fail to produce sustainable agreements due to their seemingly zero-sum nature. Once a TAC has been set, nations posture to maximize their share of the resource. This behavior can make achieving consensus on how to allocate shares costly, often prohibitively so. The NAFO and the International Convention for the Conservation of Atlantic Tunas (ICCAT) fail most often due to a lack of agreement over allocations rather than the need for management. This example has shown that stepwise agreements can facilitate cooperation by taking advantage of different economic conditions faced by participants.

The main thrust of the argument is that in designing international agreements to manage straddling stocks or in unilaterally meeting challengers to transboundary resources, policymakers must recognize economic characteristic of existing and potential adversaries. Additionally, the biological characteristics of different stocks may merit different policy responses. Uniform policies offer limited results. Instead, policymakers need to survey current and potential participants to create flexible procedures. Prime considerations include the prices fishermen face, public policies, technical expertise, and objectives in fishery management.

In many ways, input costs and public policy differentiate potential success in transboundary competition. Wage rates have played a key role in the varied profitability of fisheries in Japan, North America, and Western Europe. Higher labor and shipbuilding costs decrease a national fleet's tolerance for stock degradation, causing wealthier countries to seek international accords or defend fish stocks with unilateral action. In the race for Bering Sea pollock, both Japan and the United States cited the rising harvesting costs as the primary reason for creating mechanisms to manage pollock. Interestingly, the states that resisted the final pollock agreement, including South Korea and Poland, face lower input prices. Wealthier countries may have an advantage, however, if the differences in technological efficiency compensate for higher input costs.

Public policies offering subsidies and protection from price changes can determine a fleet's ability to withstand declines in stock levels, at times more so than input prices. Guaranteed loans for shipbuilding and fuel subsidies lead a long list of ways in which governments attempt to decrease costs to fishermen. Price supports and guarantees range from nonexistent to elaborate, with the European Union's Common Fisheries Policy being an example of the latter. Fishermen often represent valued political constituencies that can secure policy benefits on their behalf. Such policies can influence their behavior in exploiting straddling stocks.

The intangible input of experience accounts for tolerance of stock decline. Technological efficiency is not merely a matter of capital costs and expenditure on research and development. Fishers from nations with a long-standing tradition of fishing a particular stock pass down to junior colleagues skills that contribute to catch rates. Accumulated knowl-

[22] McIntyre and Warren (1996).

edge of fishing conditions lowers harvesting costs and may prolong a fleet's stay in a declining fishery.

Finally, the objectives a fleet seeks from a given fishery affect the ability to withstand stock decline. Increased mobility can allow fishermen to intensively harvest a given stock one season and then target alternative fishing grounds while the first stock rejuvenates. On the other end of the stability spectrum, countries who have decided to forego developing their own industry seek to maximize rents from foreign fishery access. If the resource in question represents a significant contribution to national income, as do tuna fisheries in the South Pacific, citizens may have little tolerance for the declines in revenues stemming from stock decline.

The differences outlined above are often cited as causes of failed negotiations among potential fishing partners. Instead, more thought should be given to using these differences in creating integrative solutions to international common property management.

APPENDIX 1: DATA SOURCES FOR THE EXAMPLE

CATCH

United States: National Marine Fisheries Service. Various years. U.S. Commercial Landings. *Fisheries of the United States.* Washington, D.C.: Department of Commerce.

ROK (Donut Hole): National Marine Fisheries Service. *World Fishing Fleets*. Washington, D.C.: Department of Commerce. Appendix F, 109.

ROK (U.S. Exclusive Economic Zone). Various years. Foreign catch by country and species. *Fisheries of the United States*.

PRICES

National price index and ex-vessel prices ($/MT) for the United States: National Marine Fisheries Service. 1992. *Fisheries of the United States 1991*. Washington, D.C.: Department of Commerce, 1 and 75.

National price index (1982 = 100) for Korea is based on wholesale price index for marine fish products, found in The Korean Statistical Association. 1992. *Monthly Statistics of Korea* 7. Seoul: Korean Statistical Association, 111.

Nontraded prices ($/MT) for Korea are based on a 1991 ROK-Sobvryflot ex-vessel pollock purchasing agreement reported in *World Fishing Fleets*, p. 94; prices for previous years are calculated using the index.

WAGES

Wage indexes (1985 = 100) are from International Monetary Fund. 1992. *International Financial Statistics.* Washington, D.C.: IMF (April): 342–47 and 552–57.

Wages in 1985 dollars are the product of wage indexes and 1985 GNP/capita, the latter from The World Bank. 1987. *World Development Report*. New York: Oxford University Press, 203.

TECHNOLOGICAL EFFICIENCY

United States: Average vessel age for United States is based on author's estimates of entry of factory trawlers directed at Alaskan pollock per year.

ROK: Average vessel age for Korea is average age of otter trawlers, given in National Marine Fisheries Service. 1993. *World Fishing Fleets.* Washington, D.C.: NMFS, 106.

REFERENCES

Bulatov, O. A., and E. I. Sobolevskii. 1991. Distribution, stocks, and fishery prospects of Walleye Pollock in the open waters of the Bering Sea. *The Soviet Journal of Marine Biology (Biologiya Morya)* 16, no. 5 (July): 297–303.

Busch, Briton Cooper. 1985. *The War Against the Seals: A History of the North American Seal Fishery*. Montreal: McGill-Queens University Press: 152.

Choucri, Nazli. 1993. *Global Accord: Environmental Challenges and International Responses.* Cambridge: MIT Press.

Dunlap, William V. 1995. The Bering Sea Donut Hole Agreement. *The International Journal of Marine and Coastal Law* 10 (February): 114–35, 118.

Gordon, H. S. 1954. The economic theory of a common property resource: the fishery. *Journal of Political Economy* 62: 124–42.

Haas, Peter M., Robert O. Keohane, and Marc A. Levy, eds. 1993. *Institutions for the Earth*. Cambridge: MIT Press.

Hayashi, Moritaka. 1991. Fisheries of the North Pacific: Japan at a turning point. *Ocean Development and International Law* 22.

Herrick, S. F., et al. 1994. Application of benefit–cost analysis to fisheries allocation decisions: the case of Walleye Pollock and Pacific Cod. *North American Journal of Fisheries Management* 14, no. 4: 726.

McIntyre, Jo, and Brad Warren. 1996. Industry scrambles to fund study. *Pacific Fishing* 27, no. 8 (August): 23–24.

Miles, Edward L., and William T. Burke. 1989. Pressures on the United Nations Convention on the Law of the Sea of 1982 arising from new fisheries conflicts: the problem of straddling stocks. *Ocean Development and International Law* 20: 343–57, 348.

Milon, J. Walter. 1993. U.S. fisheries management and economic analysis: implications of the Alaskan groundfish controversy. *American Journal of Agricultural Economics* 75 (December): 1177–182.

Plugging the Donut Hole: Fine Japan, extend jurisdiction. 1988. *Pacific Fishing* (May): 17.

Neher, Philip A. 1990. *Natural Resource Economics: Conservation and Exploitation.* Cambridge: Cambridge University Press.

Ostrom, Elinor. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action.* Cambridge: Cambridge University Press.

Shaefer, Milner B. 1954. Some aspects of the dynamics of populations important to the management of commercial marine fisheries. *Inter-American Tropical Tuna Commission Bulletin* 1, no. 2: 26–56.

Young, Oran R. 1989a. *International Cooperation: Building Regimes for Natural Resources and the Environment*. Ithaca: Cornell University Press.

———. 1989b. The politics of international regime formation: managing natural resources and the environment. *International Organization* 43, no. 3 (summer): 349–75.

HYDROPOLITICS IN POST-SOVIET CENTRAL ASIA

INTERNATIONAL ENVIRONMENTAL INSTITUTIONS AND WATER RESOURCE CONTROL

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Abstract

This project is a critical analysis of the role of international environmental organizations, at both the regional and local scale, both inter- and non-governmental, in shaping resource policy and politics in Central Asia. A study of these organizations and their influence on regional and local policies is particularly compelling in the context of Post-Soviet Central Asia's changing water resource institutions. With the collapse of the USSR, the formerly centralized system of water resource management has fragmented, leaving the five newly independent states of Central Asia vulnerable to conflicts over shared surface water resources and the remediation of transboundary environmental problems. A conglomeration of regional "associations" has formed, in part due to the interventions of multilateral donor organizations, to replace the former Soviet centralized water management apparatus. Non-governmental organizations, both indigenous and those with foreign partners, have also gained entry to the regional policy arena, attempting to ensure that local needs are addressed in regional policies—often via direct or indirect relationships with the donor organizations, thereby circumventing the state.

Introduction

International environmental organizations are influencing environmental management strategies in Central Asia with mixed results for water resource allocation and resolution of transboundary environmental problems. The collapse of the Soviet Union in 1991 effectively created meaningful political boundaries for the former republics—boundaries across which two rivers flow. Decisions affecting management of water from these rivers, once made by a distant Moscow ministry, now rest in the hands of five new independent governments with

differing political agendas.[1] Water management dec isions are complicated by both the severe environmental degradation plaguing the region and the region's economic dependence on irrigated cotton agriculture—a legacy of Soviet control.[2] Conflict between the basin states is likely, but cooperation is necessary both to ensure equitable distribution of water and to alleviate the ecological and resultant public health crisis in the region.

The heads of the five states, with the help of international organizations have forged cooperative agreements on water sharing and programs to increase irrigation efficiency. These cooperative agreements purportedly reduce the risk of regional water-related conflict by ensuring an equitable distribution of water resources among the five states. However, localized water-related conflicts have occurred between water users at political borders, raising the question of the capability of state-level cooperation to effectively address local-level resource politics. How do the policies implemented under regional (international) water agreements intersect with pre-existing locally specific struggles over access to water resources? And how do local resource politics influence the effectiveness of the regional policies as they are translated within states? If local conflicts and contestations over resources are aggravated by regional policies composed at the international level, then the overall effectiveness of regional cooperation as a preventer of conflict is diminished. Therefore, an understanding of the ways in which local resource politics and regional interests interact is essential for reducing the possibility of water related conflict in the region and in formulating effective policies for cooperative water management and environmental amelioration.

In the case of Central Asia, international organizations operate on two levels. Regionally, multilateral organizations are working with state governments to build interstate institutions for water management including water-related environmental policy. These programs include both institutional and technical assistance components. Locally, both multilaterals and foreign government agencies such as the United States' Agency for International Development offer assistance programs for small nongovernmental organizations, including environmental groups, which focus on developing the third sector in an attempt to empower local citizens. Multilateral donors as well as foreign government assistance programs have begun channeling funds to local nongovernmental organizations in the attempt to develop "civil society." The stated goal of such development is to ensure public participation in resource management and promote democratic governance.

Theoretical Foundations

International environmental politics has been addressed mostly from state-centric perspectives in International Relations and Regional Geopolitics. In the field of International Relations, environmental issues have been addressed in terms of global politics (Porter and Brown 1991, Lipschutz and Conca 1993), environmental regimes (Haas 1990, Young 1989, Litfin 1993, Young 1994), environmental security (Mathews 1989, Renner 1989, Homer-Dixon 1991, Gleick 1991, Myers 1993), and international policy and institutions (Keohane, et al. 1993, Lester 1987, Levy 1993). These analyses privilege states and transnational institutions as the primary actors. Theories of internationally shared water resources are also state-centric in that they focus on the role of water in relations between riverine states. Variables analyzed include the relative power of upstream and downstream states, the extent to which water resources are shared by more than one state, the degree of economic dependence on water, and the degree of water scarcity (Gleick 1993, Agnew and Anderson 1992).

State-centric theories are limited tools for addressing environmental problems as they focus on states as unitary actors. In most cases, interstate efforts to control environmental problems will come up against specific configurations of resource politics at the national and sub-national levels. This study is concerned with the interaction of international envi-

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[1] The five newly independent states of Central Asia are Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. Afghanistan also shares water from the Amu Darya Basin but has been excluded from formal regional agreements.

[2] The environmental problems are exacerbated by the fact that the region is a closed river basin with no ocean outlet. The Amu Darya and Syr Darya Rivers terminate in the saline Aral Sea and provide its main source of water. As irrigation withdrawals have increased from these two rivers (especially after the completion of the Kara-Kum canal in 1956), the volume of the Aral has decreased by sixty percent. The receding shoreline leaves a residue of salt and other minerals which, when carried by wind onto croplands is toxic, leading to lower crop yields and a subsequent increase in the use of chemical fertilizers to compensate. This increased use of agricultural chemicals has created a public health crisis as these toxins have accumulated in the drinking water. Incidents of respiratory diseases and cancers have increased in Karakalpakstan (the region just south of the Aral), and mothers have been advised not to feed their babies breast milk (Micklin 1991). Therefore, the Aral Sea basin is a region of profound environmental insecurity.

ronmental institutions and resource politics within states. I will, therefore, juxtapose an analysis of the state-level resource issues with local-level political ecology. The political ecology approach to understanding environmental politics analyzes patterns of resource use in relation to larger political–economic forces at varying spatial scales (Grossman 1993). Studies generally focus on a specific group of resource users and interpret environmental degradation as an outcome of complex social relations, historical circumstances, and wider geographical settings.

In attempting to bridge the theoretical gap between local and regional scales, I will draw upon an as-yet underdeveloped body of literature on nongovernmental organizations (NGOs). There is significant debate around definitions of "NGOs" and classification of them. The range of analytical criteria include scale of operation, geographic origin, programmatic focus, and source of funds (government or private) (Clark 1991, Farrington and Bebbington 1993, Crow 1992). NGOs can attack environmental problems "from above" or "from below." Because NGOs can work at varying scales (international and local) and with varying degrees of state intervention, they can serve as a vehicle through which local concerns are addressed internationally.

The link between irrigation systems, political structure and modes of production has been the focus of debate between political and social scientists for decades. Wittfogel argued that the ability of early hydraulic civilizations to control water resources was an important factor in the development of their political systems; requiring a well-organized, centralized government in order to construct, administer, and maintain extensive irrigation systems (Wittfogel 1957). He believed that the need to control water drove the development of authoritarian governments. Conversely, Glick argues the reverse; authoritarian power is the basis for the control of water resources (Glick 1971). Butzer argues that irrigation systems were centrally controlled, but on a smaller scale at the level of communities (Butzer 1976).

History of Water Resources Development in Central Asia

In the current period of rapid social, political, and economic changes, water resources dominate the political agendas of the newly independent Central Asian states. Historically, the ability to control water resources was a very important factor in the way their societies developed. There are three main phases in the development of water resources in Central Asia outlined below: the pre-Russian phase, Russian colonialism, and the Soviet period.

Pre-Russian Period

Before Russian settlement in the region, irrigated agriculture was practiced only in the river valleys which were already moist, and was mostly on a subsistence basis or for local markets. Riparian vegetation was cleared and crops often actually had lower water requirements so irrigation did not disrupt the water balance (Precoda 1991). Wheat, rice and other cereals were the main staple crops as was alfalfa for cattle. Fruit orchards, melons and vegetables were important crops. Silk and cotton were also produced and exported from the region (Pierce 1960, Smith 1992). Drinking water came through a system of Kyariz (horizontal irrigation tunnels linking underground wells), but now the Kyariz have fallen in (Precoda 1991).

The khanates were territorial units ruled by dynastic families from clan associations. They were subdivided into administrative units for the purposes of taxation and administration of water for irrigation. There were two main taxes (zekat) on merchandise, moveable property, and cattle, and tanap, a tax on land property. The land tax was generally paid in cash calculated as a percentage of the harvest. Land was the pre-eminent commodity and a sign of wealth. The land was divided into *waqf* (religious foundations) and *mulk* (freeholds) and *tankhwah* (gift lands) (Wheeler 1964, Pierce 1960, Bacon 1965).

The commercial life of the region was brisk. There was great progress in constructing irrigation canals, new towns were built, buildings were devoted to commerce. trade was conducted with Russia and other countries. Turkestan textiles were in demand all over the world and all over Russia long before the conquest. The value of exports to Russia between 1827 and 1837 exceeded that of imports by two million rubles. The exports were cotton, (raw and textiles), silk, dyes, and fruit. Goods imported from Russia were pottery, hardware, sugar, paper, tin, fur, mercury, candles, and, later, paraffin and manufactured goods and textiles. Although trade was conducted direct with foreign countries by other towns, Bukhara was by far the most important commercial center. It was in particular the center of the regional silk industry (Wheeler 1964, Pierce 1960, Bacon 1965).

Figure 1: The Amu and the Syr Daria Rivers
Source: K. Titus

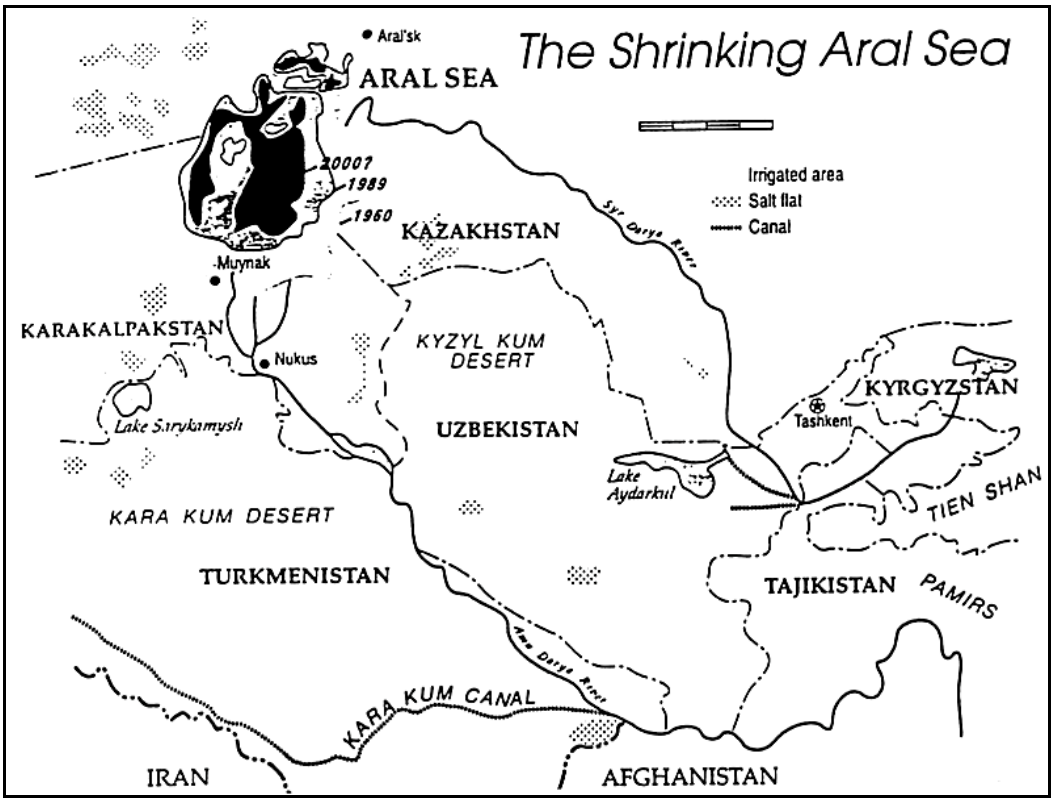

Figure 2: The Shrinking Aral Sea
Source: National Geographic (February 1990)

In Khiva, half of agricultural land was owned by the khan, and 45 percent of irrigated land by the waqf. Artificial irrigation was extensive, the canals were maintained by forced labor (the water came from the Amu Darya River). There were six main canals from seventy to one hundred kilometers in length. Seventy-five percent of the population was settled and carried on irrigation agriculture in which crop rotation was extensively practiced (Wheeler 1964).

Russian Colonial Period

While irrigated agriculture has been the basic economic activity in Central Asia for thousands of years (cotton came to Central Asia from India via Persia), cotton has only dominated agriculture since the incorporation of the Central Asian people into the Russian Empire and the imposition of central economic control from Moscow (Micklin 1991, Pierce 1960). Between 1750 and 1850 about 54 percent of the irrigated areas of the Bukhara oasis were sown to grain crops and only 25 percent to cotton (Smith 1992).

The shortage of cotton on the world market during the American Civil War (at the same time as Russia was developing its textile industry) gave Russia the impetus to colonize Central Asia in search of a supply of raw cotton. During this period, economic incentives were provided by the colonial government to induce Central Asians to grow cotton in place of traditional food crops. Desert reclamation projects were initiated to increase the area of cultivable land. Large scale irrigation networks were constructed. Many more were planned and would have been constructed had it not been for the occurrence of World War I and the Russian Revolution of 1917. Some scholars have argued that the push for increased cotton production in part was as an attempt to catch-up to pre-revolutionary levels of economic productivity. The desire to increase cotton output levels at all environmental costs intensified during the Soviet period, but by no means began at that time. The Soviet period saw an acceleration and an intensification of processes which began during the colonial period.

There were, of course, political goals in colonizing the region as well as economic ones, namely competition with Great Britain for Asian colonies and the establishment of a frontier zone to protect Russia from Mongol invasions. In many ways, irrigated cotton agriculture was used as a tool by the Russian colonial administrators to facilitate political control of the Central Asian population. Central Asia became dependent on Russia for the food crops which were no longer being grown in sufficient quantities locally. Most cotton processing and textile production was done in European Russia, creating a situation whereby Central Asia was dependent on Russia for textile products as well as for a market for the raw cotton—a situation which continued after the formation of the Soviet Union (Wheeler 1964).

Soviet Period and Development of the Aral Sea Crisis

The environmental problems of Central Asia and Kazakhstan began in the late 1950s, when Nikita Krushchev pushed his 'Virgin Lands' scheme, the aim of which was to grow wheat on the arid and semi-arid steppes of western Siberia and Kazakhstan. At the same time, the cultivation of cotton took on a new importance. As of the mid-1960s, "about half the sown area in Uzbekistan was in cotton (the rest was divided among grains, vegetables, and fodder). By 1990, cotton was sown on about two-thirds of the agricultural lands in Uzbekistan" (Smith 1992). In 1989, raw cotton exports to the West from the USSR were worth $358,913,000, which was a 1.41 percent share of their total export income. It was the sixteenth largest commodity group in terms of monetary value (SITC Database and Reuters 1992).

The Aral Sea problem is perhaps the worst case of environmental degradation in the former Soviet Union. "I doubt if there has ever been an environmental problem of this magnitude. . . . Certainly as a regional problem affecting thirty-five million people, it is unprecedented" (Micklin 1988). The environmental problems in the region can be broken down into two categories; those directly caused by the shrinking of the water body (salt storms, loss of fish species, climate change), and those associated with over-irrigation in the region (secondary salinization and loss of deltaic ecosystems). All of these ecological problems have socio-economic implications as well (drinking water contamination, increasing cancer rates, loss of agricultural productivity).

The Aral Sea began shrinking after 1960. During the 1950s and 1960s, there was a growth spurt of irrigation systems. The use of leaky and rudimentary water delivery systems in the fields has resulted in uneven and often excessive irrigation, and a lack of adequate drainage systems prevents the return of groundwater to the rivers or its reuse. When runoff is collected, it has not been put to beneficial use. Runoff from cotton and rice irrigation along the lower course of the Amu Darya has not been returned to the river, but has been allowed to flow into a desert depression creating Lake Sarykamysh (two hundred kilometers southwest of the Aral on the Uzbekistan/Turkmen

border) (Peterson 1993). Compounding the problem of huge irrigation withdrawals is the fact that the irrigation canals are so inefficient. Much more water is withdrawn than is needed.

The main use of water is for irrigation of the cotton monoculture upon which the economies of these states depends. Water development in the region has altered the natural hydrologic system in response to economic demands. Currently, 90 percent of all available water is used for irrigation (L'vovich, Koronkevich, and Yurevich 1979; L'vovich and Tsigel'naya 1978). This has led to some devastating environmental problems.

Of the 180,000 kilometers of irrigation canals in Central Asia, only 15,000 (8 percent) have linings (Reznichenko 1990). The Kara-Kum Canal is thirteen hundred kilometers long and runs directly over loose sand. It is only partially lined. Seepage losses have led to an eight hundred-square-kilometer sea along the canal in Turkmenistan (Kashtanov 1988). At least half the water withdrawn into canals leaches into the soil, never reaching the crops for which it is intended (Micklin 1988).In some cases the figure may be as high as 80 percent (Precoda 1991). Seepage from the Kara-Kum Canal has inundated the Turkmenistan capital of Ashkhabad; to prevent flooding, the authorities have had to drill one hundred and fifty wells to pump the water out of the city (Kashtanov 1988). It has been estimated that twenty-five million hectares of land not intended for irrigation are virtually swamped by misdirected water supplies (Reznichenko 1990). Turkmenistan and Uzbekistan (two republics with the largest share of irrigated agriculture) do not have sprinkler irrigation systems (Kashtanov 1988). A mere 20 to 30 percent of water withdrawn ultimately reaches the crops for which it is intended (Reznichenko 1990).

Crops in Central Asia may receive between four and six times the amount of water they require (Reznichenko 1990). Overwatering encourages erosion, and 10 percent of agricultural land has been affected (Kashtanov 1988). Swamping of irrigated land has promoted the return of malaria, a disease Soviet authorities had considered eradicated.

Prior to this recent phase of shrinking, the Aral Sea was the location of successful fishing, hunting, navigational and recreational activities. It was also considered a favorable environment for livestock and waterfowl (Glantz et al. 1991). The Aral Sea was an important shipping route between Aral'sk and Muynak, the chief ports and economic centers of the region. It was also the source of average annual fish catches of forty-five thousand to fifty thousand tons of fish (sturgeon, carp, pike, and others) (Precoda 1991). Forty thousand tons of fish per year were harvested by one fishing fleet in Muynak (Peterson 1993). Reed growth in the deltas and along the shores was used to make cardboard. As of 1991, reeds were being imported from Siberia in order to keep the plant operational and people employed. The *tugay* forest housed migrating birds and other animals and prevented erosion (Precoda 1991). Nomadic tribes raised livestock in the delta regions (Peterson 1993).

There are environmental problems not directly associated with the drying up of the sea, but with the intensive irrigation in this desert region. Perhaps the most damaging is secondary soil salinization resulting from the rising water table. As irrigation water seeps into the soil (mostly through unlined canals), the water table rises. Through capillary attraction, the ground water is pulled up through the soil to the surface (carrying salts and minerals with it), where it can evaporate, causing those salts and minerals to concentrate at the surface. There has been water logging of buildings and monuments through this same process. The salts get carried right into the foundations. Without adequate drainage systems, the water table is continuing to rise (Smith 1992).

From the mid-1970s until the late 1980s, saline damage to irrigated land in Uzbekistan increased by almost 40 percent to affect almost half of the irrigated land in the republic. The high concentrations of salt mean that the soil must be flushed with even more water in order to plant new crops each year. Therefore the crops need water year round since the flushing is done in the winter and the watering of crops is done in the spring and summer. According to the Academy of sciences Institute of Geography, the portion of irrigated land already salinized from excessive irrigation ranges from 35 percent in Tajikistan to 80 percent in Turkmenistan. the land could soon be rendered barren in as little as ten years (Peterson 1993).

In many regions, the dried salt is so thick on the soil's surface it looks like snow. In Karakalpakstan, only one-quarter of the 485,000 hectares of irrigated land are suitable for agriculture because of normal to low salt levels (Peterson 1993).

In 1988, the Soviet government conducted a series of tests of the public water supply. In the republics of Turkmenistan and Tajikistan, more than 20 percent of the samples did not meet government health standards. Five million rural inhabitants of Uzbekistan did not have running water at the close of the 1980s. In many regions of Turkmenistan such as Tashauz oblast along the lower reaches of the Amu Darya, up to 90 percent of inhabitants are forced to drink water from irrigation canals and ditches that

often carry pesticide and fertilizer laden runoff. In Tashauz, the bacteria count in the drinking water exceeded health standards by a factor of ten times, and 70 percent of the population was reportedly ill (Peterson 1993).

Drinking water contamination from agricultural chemicals and accumulated minerals is believed the main cause of high rates of intestinal illnesses, hepatitis, esophageal cancer, kidney failure and liver ailments, typhoid and cholera, and even birth defects in the region (Rafikov 1988). Conditions are most severe in the more heavily populated deltas. Muynak has an esophageal cancer rate fifteen times the national average for the USSR (Micklin 1991).

In 1965 infant mortality was 44.7 deaths per 1,000 live births (Feshbach and Friendly 1992). By 1986 it was 90 per 1,000. The infant mortality rate for the Karakalpak ASSR was 60/1,000 in 1988 and is possibly 100/1,000 some places in this republic—four times the national rate (Precoda 1991).

In 1990, 75 percent of population of Karakalpakstan suffered from various diseases. Four-fifths of the women and children suffer from anemia. In Kzyl Orda (Kazakhstan) typhoid fever increased thirty times between 1974 and 1989 with viral hepatitis up seven times (Peterson 1993). There is fear of epidemic because of the deterioration of water supply quality and the increasing rodent population. There have even been reported cases of bubonic plague (Micklin 1991).

Since the region is so dependent on its limited water supplies, and will continue to be in the future as the population grows, any change in climate which could reduce the amount of water available could have catastrophic effects on this vulnerable region.

Regional Water Resource Management Institutions

International cooperation has been taking place in Central Asia for the past five years. In February of 1992, the five Heads of States signed an agreement to manage the water resources of the Amu and Syr Darya Rivers for the benefit of all five newly independent states. In August of 1992 in Almaty the five states adopted "Protocols and Resolutions" for cooperation on protection of the water resources of the Amu and Syr Darya Rivers and for the solution of Aral Sea ecological problems. On March 26, 1993, in Kzyl Orda, the Heads of States confirmed their commitment to cooperate by soliciting support from the World Bank, which consequently stepped in to facilitate the development of regional institutions and organizations for water management and environmental amelioration.

The regional institutions created are the ICAS, the EC and the IFAS. The International Committee for Addressing the Aral Sea Crisis (ICAS) is a body of twenty-five high level representatives from the five states that meets twice a year to hold discussions, reconcile the issues of the member states, and decide on the programs, policies, and institutional proposals recommended by the Executive Council (EC). The EC is the key organization for developing policies and proposals. The International Fund for the Aral Sea (IFAS) has been established to finance the Aral Sea programs. The Fund is also intended to channel financial assistance from donor countries and international agencies for the Aral Sea programs (*Aral Sea Program* 1994).

The working relationships between these organizations and their subordinate organizations are defined as follows: the heads of states operate within the ICAS, and comprise the highest authority on water management. The EC within ICAS has the status of a foreign government with "full powers to plan and implement projects approved by ICAS" (*Aral Sea Program* 1996). Directly answerable to the ICAS are two organizations, the Interstate Commission for Water Coordination (ICWC) and the Interstate Commission for Socio-Economic Development and Scientific Technical and Ecological Cooperation (ICSDSTEC) (now called the Sustainable Development Commission SDC). The ICWC is responsible for water management issues, meeting five times a year to determine water allocations amongst the five states. They make their recommendations based on the 1992 treaty (which set the inter-state water allocations to the 1991 Soviet-era levels, which by the way, were made in a particularly wet year). The decisions of ICWC are implemented by the two Soviet-era Basin Valley Organizations (BVOs), the Syr Darya BVO and the Amu Darya BVO (Bedford 1995).

What is the impact of these regional institutions and programs on sub-national resource relations? These regional organizations have pledged not to interfere with the local systems of water rights and laws. But if the local systems run contradictory to the goals of the EC, what will be the result? How will potential conflicts be mitigated within states who currently lack mid-level political structures for conflict resolution or monitoring and enforcement of interstate agreements (a legacy of the strong state character of the Soviet period)? It is my assertion that when regional management strategies are translated

into local policies, their impact may accelerate existing disputes over water and the environment—disputes which could undermine efforts at cooperation in the region.

Water Management Within Uzbekistan

After the break-up of the Soviet Union, Uzbekistan inherited a water resources administration system bearing no relationship with physical conditions. Like in all Soviet successor states, the bureaucratic legacies of the centrally planned system include the parallel existence of numerous ministries, state committees, and departments, let alone an abundance of parliamentary committees, monitoring networks, detailed environmental and public health norms, and research institutes. Local observers hoped that the collapse of planning systems from Moscow would result in greater accountability and responsibility from Uzbek authorities. However, the outline of the water administration shown below[3] indicates that little has changed from the Soviet period organizational structure. There is still duplication of functions, unclear responsibilities, and potential for jurisdictional conflict.

Levels of Decision-Making Activities

International

The Interstate Coordination Water Committee (ICWC) is a supranational organization based on a treaty (Nukus 1994) on Principal Provisions concerning the five Central Asia Republics, aimed at the resolution of Aral Sea Basin water problems. Members are the water resources ministers of each of the five countries. ICWC's main objective is: "the determination of a uniform water management policy and development of its main directions, taking into account the states' populations and economic branches, the effective use of water resources and their protection, programs for measuring the supply of water in the river basins, and measures for their implementation." The implementation (the monitoring of distribution) is in the hands of the Basin Commissions (BVOs), which are authorized to control all withdrawals from main canals and rivers affecting more than one country and to develop limits for annual water consumption for each state. They keep ICWC informed. After collecting and adjusting water demands from water users, the basin organization distribute plans, which are updated every ten days (*Aral Sea Program* 1993). Irrigation has first priority and deficits are distributed pro-rata to all users. However, it is uncertain how long this will last, as there are signs that inter-republican cooperation may break down in times of stress (drought), for they no longer seem to accept a unified approach to the calculation of irrigation requirements.

National

The highest state representative body exercising legislative power is the Oiliy Majlis (Supreme Assembly), elected in 1994 with one hundred and fifty deputies. Its main task seems restricted to confirming the decisions of the cabinet of ministers. The Cabinet of Ministers of the Republic of Uzbekistan formally coordinates policies in the sphere of water management. Under the president, who presides over the cabinet, the Ministry for Melioration and Water management, Minvodkhoz, has primary responsibility for (1) water policy and strategy development and implementation, (2) water resources planning and the formulation of water legislation, (3) the provision of water to the various sectors of the economy, including farms, and organization and management of hydraulic works and structures. The third function is done through the ministry's oblvodkhozes and rayvodkhozes, which are in charge of the actual supply of water in given amounts. They have supervision over other institutions and executing organizations. Minvodkhoz' responsibilities only concern surface water, and they end at the boundary of the farm. Technical support and advice to farm management is provided by Minsel'khoz. Concerning this collaboration, it should be noticed that Minvodkhoz' relationship to this ministry can only grow stronger, as both ministries' powers are heavily inter-related. In other FSU republics, minvodkhozes generally disappeared as being superfluous.

District: Oblasts (13)

Apart from passing on data to higher and lower levels, oblvodkhozes' main activities consist of assessing farms' water demands by plans, distributing water after supply assessment and approval by Minvodkhoz, registration of water consumption, control of intake violations by rayons, farms and other users, and taking care for main infrastructure investments. Oblvodkhoz receives its water from the interstate river basin commissions (BVOs), and is

[3] Outline taken from (and slightly adapted by author) Bakker 1995.

responsible for delivery to the boundaries of the farms. Supply plans are differentiated for farms and broken down into ten-day periods. Formally, Oblvodkhoz is responsible to the oblast Khokim. However, as all salaries and other costs are paid by Minvodkhoz, they practically only submit to the State level. Only if in certain specific cases, e.g. shortages or new industrial planning, the Khokim can apply direct power.

Subdistrict: Rayons (154)

According to article 7 of the Laws on Water and Water Use (March 1993), functions of the local water management authorities are: (1) ensuring law and order concerning the utilization and protection of water resources; (2) determination of main trends, estimations and accountings, (3) and a special task in case of calamities. The presently existing rayvodkhozes replaced the Rayon Production Operation and Maintenance Associations, which existed before 1990. Rayvodkhozes' activities concentrate on (1) water demand and allocation to the rayon's farms, and (2) operation and maintenance of inter-farm irrigation and collector drainage systems. Firstly it is the task of rayvodkhoz staff to determine the water requirements of each farm on the basis the norm multiplied by the area of the crop. For that purpose, thick handbooks are consulted and calculations are made with the help of numbers that were developed in an ancient era. Aggregated assessments are passed up to the oblast level government body, oblvodkhoz. Secondly, rayvodkhozes' powers are limited to primary infrastructure, but from the late 1970s onward, with water scarcity growing, Rayvodkhozes also became deeply involved in on-farm management. By 1995, this practice was formally abolished. Consequently, personnel and budgets are being cut substantially and continuously. Special hydrosections (departments) within the rayvodkhoz management deal with the daily registrations of allocated and distributed amounts, and with the realization of water limits for farms. Hydrosections are guided by an engineer who is in charge of hydrometric operators and inspectors. They are allocated equally certain irrigation canals, hydrotechnical structures, farms' off-takes and hydroposts. Hydroposts, six-man units, are the measuring points in the rayon's boundaries; they compile the water supply schedules, which are corrected every ten days, depending on precipitation etc. Excessive water use is punished by fines, which are paid directly to the state.

Locality: Collective farms (+/–2,260)

On-farm management, operations and maintenance of irrigation infrastructure included is a responsibility for the farmers themselves, as rayvodkhoz had to stop all rendering of services by 1995. In practice, however, services are continued on the basis of contracts, with or without payment. Farms now have to carry out the repairing and clearing of on-farm drainage wells, pumping stations, etc. by themselves, and at their own expense. The farm level is passed over in water use activities, as rayvodkhoz deals directly with the next level: brigades.

Group:Brigades/Private Farms (+10,000)

Brigades, privatized or not, are the key elements in the farm's management structure. Land utilization is organized on brigade base, every brigade covering an area of about forty to sixty hectares and employing sixty or more people. Brigades compile the orders for water, depending on the area sown and the structure of sowings. Water demand from a certain irrigation source is considered by compiling the brigade's orders, passing over the farm level.

These management structures are very much like they were during the Soviet period—top heavy and unresponsive to local needs. The current situation could change as farm privatization progresses and with the possible implementation of water pricing.

Analysis of Institutional Effectiveness

As mentioned earlier, the challenge of designing an effective resource management strategy requires the reorganization of the existing government infrastructure to address the issues of supply, commitment and monitoring of the common property resource. Results of research by "new institutionalists" such as Elinor Ostrum suggest that many societies do in fact manage to create the necessary institutional arrangements for the minimization of "free-riding." What is required is the a balance between local and regional decision-making institutions so that incentives of the appropriators are maintained, while interregional integration is achieved. Ostrum has found that "appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities (should) be organized in multiple layers of nested enterprises" (Ostrum 1992).

In the case of Central Asia, small diverse local level micro-institutions which address local water needs as well as environmental concerns and can ful-

fill the functions of monitoring and enforcement should be nested into larger region-wide organizations which fulfill the function of mediating international cooperation between upstream and downstream states. Within this nest should be regional organizations which consider basin-wide water management in terms of ecological concerns, and not purely arbitrary political boundaries.

The international level institutional arrangements in Central Asia have the potential to prevent conflicts amongst the states, and, if decisions are made based on inputs from local level institutions, the potential for effective basin-wide, environmentally sustainable water management is great. The language of the international treaties which created these organizations is rooted in a cooperative spirit, with the realization that cooperation is necessary for economic development of the region as well as an alleviation of the profound environmental problems there.

The BVOs are also potentially very effective in terms of environmentally sound management practices. They are basin-wide management organizations which theoretically can control the allocation of water resources across state boundaries. Also, the World Bank notes that the BVO staff are highly qualified, competent, and highly motivated (World Bank 1993 as cited by Bedford 1995).

However, the nested institutions appear to end there. Although there are certainly plenty of republican level institutions existing in each of the five Central Asian states, which could participate in an integrated system of water management from the international to local levels, the necessary legislative procedures to integrate the organizations is not underway. The ICAS and the BVOs have no legal authority in any of the states. There have already been cases of heads of states striking bargains outside of the ICAS framework—most recently between Kazakhstan, Kyrgyzstan, and Uzbekistan who agreed on an exchange of water for energy in March 1996, without the consultation of Tajikistan or Turkmenistan.

Also, the ICAS treaty signed in 1992 states that historical patterns of resource allocation are to be respected. In the short term, this may have been a wise move on the part of the new government leaders—a maintenance of the status quo in order to prevent immediate haggling over water resources during the transitional period. However, the allocation figures are based on a relatively wet period in terms of the regional climate. With current speculation on the impacts of global warming in the region, not to mention normal annual fluctuations in water availability, new criteria for allocation decisions will have to be reached, which will lead to a whole new set of political considerations in the bargaining process.

Conclusions about Potential Conflicts in the Area

Within Uzbekistan is the semi-autonomous, culturally and ethnically distinct territory of Karakalpakstan. The Karakalpak people live in the delta of the Amu Darya River and are most seriously affected by the Aral Sea crisis. Any water that is diverted from the upstream portion of the Amu Darya is water that never reaches the Aral. The Karakum Canal diverts one-fourth of the Amu Darya's water from Uzbekistan into Turkmenistan, long before the river reaches Karakalpakstan, to provide irrigation water for 60 percent of the sown area of Turkmenistan (Craumer 1992). It has been proposed that the best way to forestall any further deterioration of the Amu Darya delta in Uzbekistan is to cut off water flow into the canal, with obvious economic implications for Turkmenistan. This is an unlikely occurrence, especially since Turkmenistan supplies oil to Uzbekistan, but costly improvements will need to be made on the canal to improve efficiency. What makes this example interesting is that decisions made about regional water allocation are made in Tashkent where the environmental impacts are not as visible. It is unlikely that the Uzbek state government would violate the current cooperative agreement and cut-off water supplies to Turkmenistan in order to send the water down its natural course to Karakalpakstan. Localized conflicts at the Turkmen/Uzbek border near Karakalpakstan have already occurred (Skylarov 1993, "Central Asia" 1993, "Water Loss" 1992). This is an area that has not been addressed by ICAS.

Policy Recommendations

Currently, the World Bank and other donor organizations are designing and carrying out projects geared towards institutional development and capacity building in order to aid the heads of government (inexperienced in the area of international diplomacy and negotiating) in managing transboundary resources. These programs have focused on international level organizations in an attempt to prevent regional conflict. However, if these institutions are to be sustainable under new water availability conditions and new political/economic conditions, they

must devise bargaining systems to account for potential conflicts between upstream and downstream states.

Also, the coordination of state and local level institutions with the regional ones should be addressed so as to ensure that regional decisions can be carried out locally. Perhaps even more importantly (especially in terms of environmental concerns), some feedback mechanism for the participation of local institutions into the regional ones must be devised.

REFERENCES

Aral Sea Program Donor's Meeting Report. 1994. UNEP/UNDP.

Aral Sea Program—Phase 1: Briefing Paper. 1993. The World Bank.

———. 1994. The World Bank.

———. 1996. The World Bank.

Agnew, C., and Anderson, E. 1992. Water Resources in the Arid Realm. London: Routledge.

Bacon, E. E. 1980. Central Asians under Russian rule: A study in culture change. Ithaca, NY: Cornell University Press.

Bakker, J. 1995. Water users' associations in Uzbekistan? A research on factors and pre-conditions influencing current and future performance of local water resources management. Subproject paper, TACIS-WARMAP. Tashkent, Uzbekistan: EU/TACIS.

Bedford, D. 1995. International Water Management in the Aral Sea Basin. Unpublished paper. Boulder, CO.

Butzer, K. 1976. Early Hydraulic Civilizations: A Study in Cultural Ecology. Chicago: University of Chicago Press.

Central Asia: Five state commonwealth set up. 1993. Current Digest of the Soviet Press 45, no. 1: 1–8.

Clark, J. 1991. Democratizing Development: The role of voluntary organizations. West Hartford: Kumarian.

Craumer, P. 1992. Agricultural change, labor supply, and outmigration in Soviet Central Asia. In Geographic Perspectives on Central Asia, edited by R. A. Lewis. London: Routledge.

Crow, B. 1992. Rural livelihoods: Action from above. In Rural Livelihoods: Crises and Responses. Oxford: Oxford University Press.

Farrington, J., and A. Bebbington. 1993. Reluctant Partners? Nongovernmental Organizations, the State and Sustainable Agricultural Development. New York: Routledge.

Feshbach, M., and A. Friendly. 1992. Ecocide in the USSR: Health and Nature under Siege. New York: Basic Books.

Fuller, G. E. 1990. The emergence of Central Asia. Foreign Policy 78: 49–67.

———. 1992. Central Asia : The New Geopolitics. Santa Monica, CA: Rand.

Glantz, M. H., A. Z. Rubenstein, and I. Zonn. 1993. Tragedy in the Aral Sea Basin: Looking back to plan ahead? Global Environmental Change (June): 174–98.

Gleick, P. H. 1989. The implications of global climatic changes for international security. Climatic Change 15: 309–25.

———. 1991. Environment and security: The clear connections. Bulletin of the Atomic Scientists 47: 16–21.

———. 1993. Water and conflict—Fresh water resources and international security. Natural Resources Journal 18.

Glick, T. 1971. Irrigation and Society in Valencia. Cambridge, MA: Harvard University Press.

Grossman, L. 1993. The political ecology of banana exports and local food production in St. Vincent, Eastern Caribbean. Annals of the Association of American Geographers 83, no. 2: 347–67.

Haas, P. 1990. Saving the Mediterranean: The Politics of International Environmental Cooperation. New York: Columbia University Press.

Homer-Dixon, T. 1991. On the threshold: Environmental changes as causes of acute conflict. International Security 16, no. 2.

Kashtanov. 1988. Ecological management. Vestnik Academy Nauk SSSR 11, no. 57.

Keohane, R., M. Levy, and P. Haas. 1993. Institutions for the Earth: Sources of Effective International Environmental Protection. Cambridge: MIT Press.

L'vovich, M. I., N. I. Koronkevich, and R. A. Yurevich. 1979. The water aspect of the geography of agriculture in the USSR. Izvestiya Akademii Nauk, SSSR, seriya geograficheskaya 4. Soviet Geography XX, no. 9 (November): 36–52.

L'vovich, M. I., and I. D. Tsigel'naya. 1978. Management of the water balance of the Aral Sea. Izvestiya Akademii Nauk, SSSR, seriya Geograpficheskaya 1. Soviet Geography: 42–54.

———. 1981. The potential for long-term regulation of run-off in the mountains of the Aral Sea drainage basin. Soviet Geography 22, no. 8: 471–84.

Levy, M. 1993. The Effectiveness of International Environmental Institutions. Paper prepared for the Annual Convention of International Studies Association.

Lipschutz, R., and K. Conca, ed. 1993. The State and Social Power in Global Environmental Politics. New York: Columbia University Press.

Litfin, K. 1993. Eco-regimes: Playing tug-of-war with the nation state. In The State and Social Power in Global Environmental Politics, edited by R. Lipschutz and K. Conca. New York: Columbia University Press.

Mathews, J. 1989. Redefining security. Foreign Affairs 68: 162–77.

Micklin, P. 1988. Desiccation of the Aral Sea: A water management disaster in the Soviet Union. Science 241, no. 2 (September): 1170–176.

———. 1991a. The Water Management Crisis in Soviet Central Asia. Pittsburg, PA: University of Pittsburg.

———. 1991b. Touring the Aral: Visit to an ecological disaster zone. Soviet Geography 32, no. 2: 90–105.

Myers, N. 1993. Ultimate Security: The Environmental Basis of Political Stability. New York: W. W. Norton & Company.

Ostrum, E. 1992. Crafting Institutions for Self-Governing Irrigation Systems. San Francisco, CA: Institute for Contemporary Studies.

Peterson, D. J. 1993. Troubled Lands: The Legacy of Soviet Environmental Destruction. San Francisco, CA: Westview Press.

Pierce, R. A. 1960. Russian Central Asia 1867–1917: A Study in Colonial Rule. Berkeley, CA: University of California Press.

Porter, G., and Brown, J. W. 1991. Global Environmental Politics. San Francisco, CA: Westview Press.

Precoda, N. 1991. Requiem for the Aral Sea. AMBIO 20, nos. 3–4 (May): 109–14.

Pryde, P. 1991. Environmental Management in the Soviet Union. Cambridge: Cambridge University Press.

Rafikov, A. A. 1988. The battle with desertification in the lower reaches of the Amu Darya. Melioratsiya i vodnoye khozyaystvo 9: 32–35.

Renner, M. 1989. National Security: The Economic and Environmental Dimensions. No. 89. Worldwatch Institute.

Reznichenko, G. 1990. There was not a glass of pure water added: The ecological crisis of the Aral Sea. Novyi Mir: 201–06.

Rumer, B. Z. 1989. Soviet Central Asia: "A Tragic Experiment." Boston, MA: Unwin Hyman.

Skylarov, S. 1993. Delegatsii ne podelili vodu i pastbischa (Delegations did not divide water and pastures). Kommersant Daily.

Smith, D. 1991. Growing pollution and health concerns in the Lower Amu Darya Basin. Soviet Geography: 553–65.

———. 1992a. Culture and water in Soviet Central Asia. Cultural Survival (winter): 49–52.

———. 1992b. Salinization in Uzbekistan. Post-Soviet Geography 33, no. 1: 21–34.

Water Loss Sparks Fights. 1992. RM News.

Wheeler, G. 1964. The Modern History of Soviet Central Asia. London: Weidenfield and Nicolson.

Wittfogel, K. A. 1957. Oriental Despotism: A Comparative Study of Total Power. New Haven, CT: Yale University Press.

Young, O. 1989. International Cooperation: Building Regimes for Natural Resources and the Environment. Ithaca, NY: Cornell University Press.

——. 1994. International Governance. Ithaca, NY: Cornell University Press.

WATER USUALLY FLOWS DOWNHILL

THE ROLE OF POWER, NORMS, AND DOMESTIC POLITICS IN RESOLVING TRANSBOUNDARY WATER-SHARING CONFLICTS

Paul Williams

Abstract

This paper addresses a subset of historical and current international political disputes: those involving conflict between powerful upstream states and weaker downstream states over sharing the water resources of transboundary rivers. An examination of the empirical record in five cases indicates that even though weaker downstream states lack the military and economic resources deemed necessary and sufficient to induce the upstream state to mitigate its hydrological activities—chiefly water diversions—the former states can generally attain water-sharing arrangements which preserve their existing water uses. As these cases show, the degree of the powerful upstream state's restraints on its own water diversions derive from the downstream state's appeals to norms of cooperation and compromise applied within the borders of the upstream state and the former state's exploitation of water-sharing conflicts among the upstream state's own water users.

Introduction

Recent reports observe that international freshwater resources, especially transboundary rivers, are playing a larger role in conflicts between neighboring countries ("Water in the Middle East" 1995–1996). Attributing transboundary water-sharing conflict to the growing general scarcity and degradation of water supply sources, some studies have focused notably on the need to address such aggravating factors as global climate change, unchecked population growth, and culturally rooted obstacles to the market pricing of water.1 While acknowledging the necessity and desirability of mitigating global water scarcity, this paper analyzes transboundary water-sharing conflicts in order to discern the political conditions under which states can formally resolve these conflicts in the context of scarcity.

[1] The signature analysis of the connections between environmental deterioration and political conflict remains Homer-Dixon (1991). For a more critical view of this conceptual framework, see Levy (1995).

The focus here concerns a particularly noteworthy subset of transboundary water-sharing conflicts: those revolving around actual or imminent increases in water diversions within upstream states. Departing from the conventional view that upstream states restrict their hydrological activities only in response to the structure of external military and material incentives, this paper offers a more nuanced depiction of the political motivations behind these restrictions. This explanation relates the formal resolution of water-sharing conflicts of lack thereof to liberal norms (namely, that the rule of law and principle of compromise should govern the process of finding lasting settlements) and democratic political institutions (especially majority rule) within the upstream state. More specifically, this paper shows how both the upstream state's normative interest in accommodating the downstream state's water uses and the material interest of the upstream state's own water users in curbing certain water diversions can result in greater restrictions on these water diversions.

The first part of this paper provides a critical survey of the conventional explanations of why upstream states limit the negative effects of their hydrological activities on the downstream state's water uses. The next section presents an alternative explanation for these limitations, and the third section examines how the various explanations measure against empirical events in five case studies. The fourth part discusses policy implications for the two cases where formal, or codified, accords do not govern the existing water-sharing arrangements, and the final section contains concluding remarks.

Conventional Explanations of Cooperation in Transboundary Water-Sharing Disputes

Realism: Downstream-State Coercion

Long the dominant paradigm for understanding international conflict and cooperation, structural realism takes a highly pessimistic view of cooperation between states. According to this approach, states are the units of action, and their relations occur in an anarchic environment—an environment gin which they cannot rely on a supra-national authority to protect their national interests. Unable to depend on others for their national security, states measure their own gains against those of others (Waltz 1979, 6 passim). Either they compete for shares of a fixed pie, or fear that cooperating to increase the size of mutual gains will result in other states gaining relatively more and converting present economic gains into future military advantages. For realists, concern for relative gains eliminates most areas of common interest between states.[2]

The concern for relative gains furnishes a logical motive for international competition over scarce transboundary water resources. Where disputed transboundary resources flow in one direction, the distribution of military capabilities either exacerbates or mitigates the effects of geographic position. That is, downstream states have to use coercion (including their own military capabilities, those of powerful military allies, and their upstream position on other transboundary rivers) to balance their geographic status on the particular transboundary river at issue.[3] In the 1960s, for instance, Israeli armed forces destroyed an Arab League-funded conduit designed to divert Jordan River water away from Lake Kinneret (Sea of Galilee), and for the last three to four decades, Egypt has ensured the flow of Nile River water to" the Aswan Dam by blocking certain Sudanese and Ethiopian irrigation projects.[4]

Liberalism: Upstream-State Economic Dependence

Adopting realism's assumptions about states as the primary units of action in an anarchic international system, liberalism takes a more sanguine view of international cooperation. This view holds that in certain interactions (e.g., trade, certain joint water-storage projects), states desire to enlarge individual gains regardless of how their gains stack up to those of other states. The Prisoner's Dilemma (PD) game figures prominently in liberalism's story about cooperation. Playing the game only once, both players would like to exploit each other's cooperation by cheating, even though mutual cheating leaves both players individually and collectively worse off than if they both had cooperated. However, where states expect to interact with each other indefinitely, reciprocity (that is, conditioning one's own cooperation on the cooperation of others) can move both states to the Pareto-optimal, or "win-win," outcome of mutual cooperation.[5] Sustained cooperation then presupposes

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[2] Credit for the neorealist response to the argument that states are mainly concerned with maximizing wealth or individual gains goes to Grieco (1988) and Grieco (1993).

[3] See Naff and Matson (1984, 9, 193, 195); Lowi (1993, 10, 203).

[4] See "Water in the Middle East" (1995–1996). While Israel has blocked World Bank funding for the joint Syrian–Jordanian "Unity Dam" ten kilometers southeast of the Golan Heights on the Yarmuk River, it has chosen not to prevent Syria's construction of twenty-seven small dams upstream on the Yarmuk, viewing the latter's promotion of farm settlements on the Syrian side of the Golan Heights as conducive to preventing Syrian attacks against the Israeli side. See Kershner (1990).

[5] Reciprocity refers to Axelrod's Tit-for-Tat strategy (cooperate on the first move and then do whatever the other player did on the previous move). See Axelrod (1984) and Axelrod and Keohane (1986).

success in surmounting the problems of identifying and sanctioning cheating: the larger the number of states involved, the higher the information costs associated with cooperation.[6] For liberalism, the problem of cheating pervades common-pool resource issues, where each use of the resource can substantially harm all other uses. Binding solutions to common-pool resource (CPR) problems, such as depletion of a grazing commons or a shared aquifer, require enforceable restrictions on every resource user.[7]

Where asymmetry characterizes access to natural resources (that is, where one set of users can diminish another's uses, but not vice versa), generalized cheating does not pose a significant obstacle to the emergence of "win-win" solutions. In the area of asymmetrical transboundary water-sharing, "win-win" solutions can sometimes inhere in the technological orientation of upstream state's hydrological facilities. According to the principle of integrated river basin planning, optimal water use mandates integrated development of the basin (a form of cooperation for mutual gains), even though the concomitant requirement of supra-national river basin commissions poses formidable political challenges to the practical implementation of this principle.[8] With insufficient water-storage capacity, the natural variation in the flow of water can exacerbate competition not only between states but within the upstream state itself, because higher discounting of the value of dependable future water flows causes both upstream and downstream water users to attempt to maximize present water uses.[9] Theoretically, if the upstream state anticipates gaining sufficiently large benefits from mitigating the insecurity of water uses among its own upstream and downstream water users, it may underwrite the entire cost of water-storage facilities, which can also serve to increase the security (a positive externality, or uncaptured benefit) of the downstream state's water uses.[10]

More often, however, the upstream state's hydrological facilities interfere to some extent with the downstream state's water uses. Often, the upstream state requires water-storage facilities to pay for themselves with hydro-electric power generation. While the resulting hydropower production per se does not permanently diminish the quantity and quality of water in the downstream state, the timing of power generation may clash with the downstream state's water uses (for instance, if the upstream state's peak demand period for hydropower follows in sequence the downstream state's irrigation season).[11] In more extreme competitive circumstances, the upstream state expands water-diversion capacity along with increased water-storage capacity: this produces negative externalities (harmful by-products the costs of which the producer does not bear) of a more permanent nature in the downstream state.[12] The upstream state's dependence on multilateral funding institutions (e.g., the World Bank or Asian Development Bank) or on the downstream state itself for economic assistance to build its hydrological facilities better guarantees compatibility at the outset between the basic technological configuration of these facilities (i.e., having a minimum water-diversion capacity) and the downstream state's water uses.[13] Nonetheless, even if the militarily dominant upstream state also does not need outside economic assistance to finish its hydrological projects, it may still want to limit the harmful uses of these projects in order to gain concessions on a larger basket of linked issues (e.g., access to downstream state markets, transit rights, and other natural resources).[14]

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[6] On the number of states as a barrier to cooperation, see Wishart (1990).

[7] Common-pool resources resemble public goods in that beneficiaries cannot be excluded, but differ in that they are subject to "crowding" (where one user's consumption of the good reduces another user's consumption). The most extensive theoretical and analytical treatment of how resource users resolve common-pool resource problems is found in Ostrom (1990).

[8] The concept of integrated river-basin planning relates to the theory of "co-riparian communalism" (also referred to as the "community theory," "commonwealth doctrine," etc.). See Naff (1993). On the axiomatic preclusion of strong supra-national river-basin commissions in an anarchic international system and Pareto-Admissibility as a criterion for water-sharing solutions, see Rogers (1993, 120-21).

[9] Emphasizing a high discount rate as a primary inhibitor of cooperation is Axelrod (1984, 13, 174). Implying that irrigation can have a defensive motivation, one source notes in passing the protective type of irrigation in areas on the Indian side of the Ganges basin. See Rao (1975, 74).

[10] Olson notes that some individual benefit enough to bear a disproportionate share of the costs of a collective good. See Olson (1971, 23). That gains in the security of some water uses do not necessarily decrease the quantity of other water uses resembles by analogy the point that absolute gains in national security do not necessarily increase the insecurity of others. See Glaser (1994–1995).

[11] Rogers distinguishes base load hydropower, which helps regulate the river, from peak load hydropower, which can create additional peaks. See Rogers (1993, 119).

[12] Negative externalities constitute harmful by-products—for example, upstream water uses that increase the scarcity and pollution of water flowing downstream—for which the upstream state does not bear the cost. On the definition of externalities, see Rogers (1993, 118) and Frey (1993, 19).

[13] On the role of conditional multilateral funding, see Zaman (1982, 186).

[14] On reference to linkages between water-sharing and other economic issues, see LeMarquand (1977, 13). That an upstream state might choose to trade its water for other goods instead of hoarding that water resembles the notion that states might forgo territorial aggrandizement, which carries increasingly prohibitive costs in the nuclear era, in return for making economic gains through trade. See Rosecrance (1986).

Are Downstream-State Material Linkage Strategies Always Feasible, Desirable, and Necessary?

The paradigm of liberalism widens the analytical scope of system-structural logic to encompass mutual economic gains as an additional way in which the downstream state can ensure that upstream-state facilities do not pose egregious harm to the former's water uses. However, the paradigm logically converges with realism in resorting to external material linkages to account for cooperation in the context of the upstream state's contemplation of hydrological activities which cause severe permanent harm to the downstream state's water uses.[15] Nevertheless, not all highly competitive scenarios make material linkage strategies feasible, desirable, or necessary.

First of all, linkage strategies can have limited feasibility or efficacy. The upstream states in the cases below increased water-diversion capacity with minimal outside economic assistance, explicitly or implicitly deterred the downstream state and its military allies from attacking the upstream state's hydrological facilities, and did not require the downstream state's cooperation in extraneous economic issue-areas. Use of these strategies can even backfire on the downstream state. That is, as Mexico's and Syria's respective strategies in bargaining over the Colorado and Euphrates Rivers attest, linkages may stiffen the upstream state's political resistance to any international accord with unfavorable redistributive implications.[16]

Secondly, the downstream state may not even require linkages. As the next section explicates, under certain circumstances, it can appeal to the upstream state's domestic normative inhibitions against invading the downstream state's established water uses. In addition, the downstream state can take advantage of the fact that increased water diversions may have a deleterious impact on other water uses in the upstream state.

Alternative Explanation

The alternative explanation assumes that states neither act as unitary rational actors nor define their national interests exclusively in line with the distribution of martial and economic capabilities. It incorporates normative as well as domestic political interests into the calculus of those who determine the upstream state's behavior in the area of transboundary water-sharing. Specifically, this explanation posits that restrictions on the upstream state's water diversions, crucial to maintaining the downstream state's water uses, correlate positively with the upstream state's norm-based interest in accommodating the downstream state's water uses and the direct material interest of the upstream state's own water users in restricting certain water diversions. The first part of this section develops the analytical and conceptual framework of the alternative hypotheses, the second enumerates the assumptions upon which the hypothetical propositions are based, and the third subsection defines and describes these propositions in detail.

Analytical and Conceptual Framework

Multilevel games analysis and the "democratic peace" hypothesis provide the analytical and conceptual framework, respectively, for relating liberal norms and democratic political institutions to the upstream state's restrictions on its own water diversions. The analytical construct of multi-level games encompasses not only inter-state bargaining, but also efforts of foreign-policy negotiators in each state to negotiate with domestic political factions within both states. One prominent articulation of this approach focuses on strategic manipulation of "win-sets," which encompass all domestically ratifiable international agreements. Successful manipulation demands a delicate balancing act: if they desire an international agreement, foreign-policy negotiators must signal the sufficiency of domestic political support for ratification as well as relatively tighter political constraints on accepting a smaller apportionment of the resulting pie. To loosen each other's domestic constraints, foreign-policy negotiators use pressure or side payments to try to alter the preferences or composition of the opposite state's dominant political factions (Putnam 1988, 427–60).[17] According to a refinement of this approach, foreign-policy negotiators internationalize issues to widen the ambit local participation on these issues and link international issues to recognized local problems in the opposing state (Schoppa 1993, 353–86). On the other end, negotiators must also attempt to consolidate domestic political support, which they can do by offering internal side payments and redefining narrower eco-

[15] This point corresponds to the idea that strictly competitive games (such as offensive arms races or some water-sharing conflicts) erase the distinction between absolute and relative gains. See Stein (1990, 120–23, 196).

[16] On the counterproductive effects of "blackmailing," see Axelrod and Keohane (1986, 240).

[17] Others note that larger regions of feasible agreement can actually make agreement less likely if both parties are intent on securing the largest share or if the increase in that region increases the best hopes of one player. See Axelrod (1970, 46–57, 86–87) and Mayer (1992, 797–99).

nomic issues as national security concerns.[18] While not addressing the political basis of support for more redistributive agreements, such as water-sharing, the multi-level games framework makes an important analytical contribution by elucidating the place of domestic political interests and alignments in the calculus of foreign-policy decisionmakers.

The "democratic peace" argument yields cogent conceptual insights into how liberal norms and democratic institutions can mitigate the influence of coercion in interactions between stronger powers and weaker states. According to one version of this argument, liberal ideas (viz., that individuals should cooperate for self-preservation and material well-being) foster a liberal foreign policy ideology (which prohibits war with other liberal democracies and sometimes encourages war with illiberal states) and democratic institutions (especially freedom of the press and competitive elections), both of which raise the domestic political costs of war between liberal democracies. Even when illiberal leaders (e.g., realists) of a liberal democracy would like to go to war with another state, domestic opponents who recognize the other state as a liberal democracy can use the free press and competitive elections to punish any illiberal leaders who push for war. Conversely, when leaders of a liberal democracy wish to refrain from fighting another state, domestic proponents of war who consider this other state illiberal (that is, not respecting individual rights and freedoms) can use the same democratic institutions to agitate for war (Owen 1994). As demonstrated below, the alternative explanation of an upstream state's restrictions on its own transboundary water diversions incorporates an analogue to the "democratic peace" argument, modified to account for substantive differences between warfare and large water diversions.

Assumptions

One set of assumptions concerns the identity of the actors in the upstream state who dominate policymaking in the area of transboundary water issues. First, the ultimate responsibility for setting policy in this area resides in foreign-policymaking authorities, who perform the executive (negotiating) and legislative (ratifying) functions of the national government. The foreign-policy executive has primary responsibility for responding to the constraints and opportunities of the international system. In keeping with this responsibility, the upstream state's foreign-policy executive assesses the merits of water-sharing agreements, which necessarily entail restrictions on diversions of water within the upstream state, according to some overarching conception of the national interest.[19]

Secondly, legislative ratification of international water-sharing agreements requires the support of a majority of transboundary water users in the upstream state. Fully mobilized to protect their interests, especially within the legislature, "rent-seeking" coalitions of water users represent the greatest potential obstacle to gaining legislative ratification of redistributive water-sharing agreements (i.e., those which allow more water to flow downstream). With the aim of settling less developed semi-arid regions, increasing food production, and stimulating overall economic growth, central governments almost universally promote large-scale water uses. Irrigation consumes the bulk of water used (and diverted) even in arid regions of the world, but generally does not meet the criteria of economic efficiency (i.e., that the price charged for water exceed or equal the cost of an additional unit of water in a given use) because the government subsidizes both the required water-diversion facilities and the resulting agricultural output. "Rent-seeking" occurs where water users essentially capture the relevant subsidy programs in order to concentrate the benefits of these subsidies among themselves and let the larger body of taxpayers absorb the costs. In order to gain the necessary legislative support for an unfavorable international distribution of water within a setting where "rent-seeking" behavior predominates, the foreign-policy executive must mobilize a taxpaying majority who have tangential interests in using transboundary water or exploit distributional conflicts within "rent-seeking" coalitions.[20]

Another group of assumptions pertains to the substantive distinctions between water diversion and military warfare. First, the upstream state's ability to control the volume of water diversions presupposes successful deterrence of any attacks against hydrological facilities under construction; consequently, the implied military imbalance favoring the upstream state also means a lower probability of actual warfare over increased water diversions. In addition, whereas warfare generally represents a "lose-lose" proposition for both of the belligerent states, larger water diversions provide material gains to at least some transboundary water users in the upstream state. In other words, the upstream state may have the ability to concentrate the most severe water shortages, attribut-

[18] See Friman (1993, 387–410). Another author notes that negotiators will favor internal side payments when internal political divisions constitute a net liability in external bargaining (where bargaining is positive-sum), but not when political divisions constitute a net asset (where bargaining is constant-sum). See Mayer (1992, 816–17).

[19] This definition of "foreign-policy executive" essentially parallels that of Lake (1988, 67).

[20] On governments' costly subsidization of inefficient water uses, notably irrigated agriculture, see Richards (1993). The ability of certain groups to overcome collective action dilemmas in organizing to represent their economic interests is discussed in Olson (1971, 53–57) and Lake (1988, 70).

able at least in part to its population's water uses, within the downstream state without unduly harming the former state's water users. Thirdly, because increased water diversions generally reflect egoism (i.e., the desire to enhance material gains regardless of the effects on the downstream state), not a desire to punish the downstream state, the upstream state's foreign-policy executive cannot formalize water-sharing arrangements which require a majority of upstream state water users to relinquish water.[21]

Hypothetical Propositions

In two ways, liberal norms and democratic political institutions constrain the upstream state's diversions of transboundary water. Liberal democracies practice liberal norms, including the application of the principles of cooperation and compromise to the lasting settlement of disputes. One of these norms pertains to the substantive content of dispute settlements: populations in liberal democracies generally seek just settlements. By denying both downstream Kansas's right to a undiminished flow of Arkansas River water and upstream Colorado's right to dispose of all waters within its borders without regard to the effects on Kansas, the U.S. Supreme Court's decision in *Kansas v. Colorado* (1907) set a new standard for just settlements of water-sharing disputes. This decision first promulgated the "equitable utilization" or "equitable apportionment" doctrine, which holds that each water user should receive a "reasonable and equitable" share of water.[22] While it does not imply its own political feasibility in particular situations, this principle has emerged as the most widely espoused guide to resolving domestic and transboundary water-sharing disputes.[23] Practical application of this doctrine usually, but not in any inflexible way, assigns a greater weight to present or existing water uses of a beneficial nature (for example, those that lead to "established economies") than to future or contemplated water uses.[24] The other related liberal norm concerns the proper procedure for resolving disputes cooperatively. Liberal democracies generally adhere to the idea that if and only if direct negotiations fail should adversaries proceed to adjudication or arbitration. Given their experience with litigation of complex disputes involving the allocation of scarce water supplies, some liberal democracies, especially those possessing a federal or quasi-federal structure (e.g., Australia, India, the United States), prefer to settle these disputes via mutual agreement rather than through adjudication.[25]

Unilateral expansions in the upstream state's capacity to divert transboundary water will almost certainly lead the downstream state to seek a formal water-sharing arrangement. Perceived obduracy in trying to get the opposite state to accept less than what the latter recognizes as its minimum established water uses serves as one catalyst of negotiation failure. As one of the assumptions of the previous subsection stated, the unilateral construction of the internationally controversial water-diversion facilities in the upstream state demonstrates ipso facto the ineffectiveness of the downstream state's resort to material linkage strategies. Thus, the downstream state may confine its opposition to adopting an uncompromising stance, which can embody the indiscriminate verbal condemnation of the upstream state's hydrological activities. Nonetheless, by exhibiting a lesser estimation of norms of cooperation and reasoned compromise, the extremism of the downstream state's position may risk undermining the upstream state's normative compunctions against unconstrained water diversions.

As an alternative to the intensification of verbal and political hostility, the downstream state can seek adjudication or arbitration in hopes that a neutral entity will concur in that state's assessment of the eq-

[21] This account emphasizes mitigated egoism as the default behavior of the upstream state. While observably consistent with the use of hydrological facilities for ulterior political purposes, the upstream state's detrimental use of its facilities derives fundamentally from the failure to constrain the fulfillment of egoistic individual economic objectives. That water has an instrumental (political) as well as intrinsic (economic) value is noted in Frey (1993, 31).

[22] See Ramaswami (1978, 515–16).

[23] In one form of another, the doctrine has appeared in numerous sources: the U.S. Supreme Court decisions in *Wyoming v. Colorado* (1922) and *Nebraska v. Wyoming* (1945); the Indus (Rau) Commission Report (1942), appointed to investigate the complaint of the Province of Sind against the State of Punjab over the latter's proposals to divert the waters of the Indus River; the respective apportionments of the waters of the Mahi and Karamnasa rivers in India; Article IV of the International Law Association's 1966 Helsinki Rules on the Use of Waters of International Rivers; the 1977 United Nations Water Conference; the 1991 United Nations International Law Commission's provisional Law of the Non-Navigational Uses of International Watercourses; and over one hundred bilateral treaties. See Jain, Jacob, and Jain (1971, 154–71), Abbas (1982, 72), and Gleick (1992, 21).

[24] This idea finds expression in such U.S. Supreme Court decisions as *New Jersey v. New York* (1931) and *Nebraska v. Wyoming* (1945), as well as Article VII of the 1966 Helsinki Rules. See Jain, Jacob, and Jain (1971, 160–61, 164, 167).

[25] In the U.S. system, for instance, while Article III, Section 2 of the U.S. Constitution leaves the matter of resolution of U.S. inter-State disputes within the original jurisdiction of the United States Supreme Court, Article I, Section 10 allows States to enter into mutual agreements with the consent of the U.S. Congress. The Court itself has declared, in *New York v. New Jersey* (1921), *Colorado v. Kansas* (1921), and *Nebraska v. Wyoming* (1945), its own preference for mutual accommodation over adjudicated settlement. See Jain, Jacob, and Jain (1971, 112–14). Article 262 of India's Constitution provides for adjudication of inter-state water disputes and Section 4 of India's 1956 Inter-State Water Disputes Act further provides for adjudication for tribunal if negotiations fail. See Ramaswami (1978, 509–11).

uitability of its water uses. Ironically, wider opportunities for the downstream state to pursue international adjudication or arbitration may increase the incentives of the upstream state's foreign-policy executive to formalize a water-sharing arrangement (akin to an "out-of-court" settlement) by which the latter must restrict its water diversions in order to accommodate the downstream state's water uses. On the other hand, waiting for "court" hearings to proceed to a formal decision, rather than expediting a settlement on the bilateral track, puts the foreign-policy executive at a higher political risk. The concerns of the population of a liberal democratic state do not relate simply to the expected damage to the upstream state's external image. For the population of a liberal democratic upstream state, a neutral entity's recognition of the downstream state's present water uses creates a more severe internal dissonance between the act of increasing diversions of transboundary water and the upstream state's own time-tested normative practice of seeking compromise solutions to domestic water-sharing conflicts.[26]

The first set of hypothetical propositions encapsulates the thrust of the preceding passages:

- H1a: more (less) probable neutral recognition of the downstream state's water uses increases (decreases) the level of the upstream state's norm-based interest in accommodating those water uses
- H1b: stronger (weaker) norm-based interest results in more (less) restricted water diversions which benefit (harm) the downstream state directly

In 1944, approximately one year after the Mexican government informally communicated its desire, albeit reluctant, to submit the unresolved Colorado River water-sharing controversy to international arbitration, the United States government had gained the necessary support of a majority of U.S. Colorado River Basin States and had signed a water-sharing accord granting Mexico 1.5 to 1.7 million acre-feet of water, double the offer which most of the relevant political units (states) of U.S. Colorado River water users had previously been willing to grant Mexico.[27] In another case, within one year of explicitly submitting the unresolved Ganges River water-sharing dispute to the relatively neutral forum of the United Nations in late 1976, the Bangladesh government had succeeded in calling into question the viability of the Indian government's preferred policy of bilateral negotiations and thus increased the domestic political costs to the Indian government of failing to expedite a cooperative Ganges River water-sharing arrangement.[28].

Even when the norm-based interest in accommodating the downstream state's water uses remains weak, democratic political institutions can strengthen the power of those with a direct material interest in restricting diversions of transboundary water in the upstream state. In many cases, less restricted water diversions, by virtue of their location and magnitude, may fail to accommodate not only the downstream state's water uses, but also those of other transboundary water users within the upstream state itself. Where the latter water users form a political majority, they can better utilize democratic institutions (especially in legislatures where majority rule operates) to limit the controversial diversions. Where this majority comprises most of the upstream state's general population, it can exert its political clout directly. Alternatively, by signaling to the larger population with tangential interests in transboundary water use where the interests of the majority of water users lie, the aggrieved water users can rally greater public support for imposing restrictions on water diversions. This majority constitutes either an active or latent "ally" of the downstream state. On the other hand, where the upstream state's increased water diversions affect only the downstream state, a majority of upstream state water users has a lower likelihood of "allying" with the downstream state.

The above passage yields a second set of hypotheses:

- H2a: water diversions which harm a larger (smaller) number of other upstream-state water users increase (decrease) the upstream state's material interest in restricting transboundary water diversions
- H2b: stronger (weaker) material interest results in more (less) restricted water diversions which benefit (harm) the downstream state indirectly

Increased transboundary water diversions can harm upstream-state water users in several ways. First, water diversions further upstream can harm

[26] One author notes that a powerful country's concern for its image as a "good neighbor" and a model of cooperative international behavior and its desire to build up a "reservoir of good will" may induce it to pay close attention to how its self-interested actions affect its weaker neighbors. See LeMarquand (1977, 12–13). Another source notes a similar value of favorable image in the international community, relating it to a nation's structural position in the world system, but does not elaborate on the nature of the image-structure relationship. See Frey (1993, 34–35).

[27] Information on the outside threat of Mexican arbitration and the U.S. federal government's use of this threat to garner support for a permanent water-sharing accord comes from U.S. Department of State (1965, 593–96, 605, 618–19, 628) and Hundley (1966, 98, 104, 123–25, 128, 135–36, 146–47, 158, 167).

[28] On assessments of the efficacy of using the neutral forums of the UN General Assembly in 1976 and the UN Water Conference in 1977 to promote Bangladesh's case for a Ganges River water-sharing accord, see Abbas (1982, 54–66, 69–75); Begum (1988, 169–172).

pre-existing water uses further downstream if the latter uses lack sufficient legal protection.[29] In extreme cases, the downstream state and downstream water users in the upstream state draw their water from the same location on the transboundary waterway. Thus, both sets of water users suffer in a roughly symmetrical manner from increased water diversions further upstream. In the late 1800s and early 1900s, for example, water diversions in southern Colorado and the northern part of New Mexico exacerbated the effects of drought in the geographically inferior Juarez–El Paso Valley straddling Mexican and U.S. territory; as a result, Texas exploited the "internationalization" of a largely local water-sharing issue to gain a federal injunction against subsequent increases in the offending water diversions.[30]

In some cases, however, earlier increases in the upstream state's transboundary water diversions further downstream can impair present water uses in the downstream state and later water uses in areas further upstream within the upstream state. That is, these increased water diversions can gain legal precedence over desired water uses located at points further upstream if earlier water diverters can secure these increased diversions through the legal doctrine of prior appropriation (i.e., "first in time, first in right").[31] In this situation, those expected to benefit from later water uses have the dominant incentive to restrict the earlier diversions. Fearing that certain hydrological facilities in the Lower Basin of the Colorado River were expanding the baseline quantity of water uses in both California and Mexico at their expense, the States of the Upper Basin spearheaded efforts to assert federal control over these downstream water diversions.[32]

Water diversions can infringe upon other important water uses within the upstream state in a third way. Some single hydrological facilities contain dual, but competing, functions, such as hydro-electric power generation and water diversion. Diverting stored water into conduits for off-stream water uses (e.g., irrigated agriculture, etc.) necessarily reduce the quantity of water available for generating hydropower.[33] Besides providing the upstream state with a clean and remunerative source of energy, hydropower releases relatively good-quality water to the transboundary river further downstream, thus conferring certain indirect benefits on the downstream state. In short, hydropower consumers comprise a potential opposition to increased water diversions. In Turkey, for instance, the multipurpose Ataturk Dam's hydropower operations are already providing significant energy benefits to populations in western regions of the country, indicating a potential barrier to future increases in water diversions designated for irrigated agriculture in the poorer provinces of Southeast Anatolia.[34]

Even where norm-based interests, rather than the direct material interests, account for restricted water diversions, formal water-sharing agreements require majority political support. The national government can more easily get this support when the costs of these restrictions do not fall on the majority of water users. Subsequent to the signing of the 1977 accord allocating Ganges River water between India and Bangladesh, for instance, interests in the Indian state of West Bengal, whose Farakka Barrage and Feeder Canal Bangladesh singled out for criticism, complained about the central government's failure to compel water diverters in the further upstream "Hindi-Belt" States of Uttar Pradesh and Bihar to share the overall burden of the 1977 Ganges River accord.[35]

Figure 1 combines the preceding sets of hypothetical propositions in a single schematic diagram. As this figure shows, the upstream state's upstream-state norm-based interest in accommodating the downstream state's water uses and that state's material interest in restricting certain of its own water diversions represent two intervening variables. Depicting these variables as dichotomous for stylistic purposes, Figure 2 provides an additional graphical account of how these variables relate to the outcome of more or less restricted water diversions, and matches each of the five case studies discussed below to the most representative outcome cell.

According to the upper-left cell, the outcome of more restricted water diversions benefits both states directly. In other words, they provide direct benefits to the downstream state as well as the majority of water users in the upstream state. As depicted in the upper-right cell, if only normative concerns motivate more restricted water diversions, these restrictions provide direct gains to the downstream state only. That is, these restrictions impose most of all of the costs of a formal water-sharing agreement on a minority of water users in the upstream state without necessarily providing a majority with any positive gains. According to the lower-left cell, if only mate-

[29] Historically, downstream areas have tended to develop faster than upstream areas because of the developmental primacy of agriculture and the relative ease of cultivating flatter areas as opposed to steeper terrain. See remarks of Stephen C. McCaffrey in American Society of International Law (1990, 235).

[30] See Hundley (1966, 17–40).

[31] On prior appropriation doctrine as applied in the arid western regions of the United States, see Getches (1990, 78–191).

[32] See Hundley (1966, 49, 81–82, 119).

[33] On the problem of functional trade-offs for Turkish multipurpose dams on the Euphrates River, see Kolars (1993, 70–71).

[34] Business interests in Turkey's southeast regions hint that the benefits (mostly hydropower) of the existing components of the eponymous Southeast Anatolia Project are flowing mostly to the western regions. As reported in "The War That Cannot Speak Its Name" (1996).

[35] See Begum (1988, 183, 186).

rial interests drive more restricted water diversions, these restrictions will provide indirect benefits to the downstream state only to the extent that a majority of the upstream state's water users receive direct benefits as a result. Finally, as shown in the lower-right cell, the outcome of less restricted water diversions provide direct benefits to most or all of the upstream state's water users at the downstream state's expense.

Test of Explanations against the Empirical Record

This section tests the conventional and alternative hypotheses against the observed record of transboundary water-sharing conflict and conflict resolution in the five cases arrayed in Figure 2. Each of these studies focuses on the degree to which upstream states restrict their respective water diversions until they agree to conclude a formal, or codified, resolution of the particular water-sharing conflict. Accordingly, each case parametrizes the upstream state's ability to construct the expanded water-diversion capacity over the downstream state's opposition. By controlling for the upstream state's military power and economic self-sufficiency, the design of the case studies allows for a clearer test of how the latter state's normative values and political institutions condition its water diversions. However, in order to show more definitively that these latter variables account for water-diversion restrictions in the upstream states, each case study examines the nature of the downstream state's use, non-use, or misuse of material linkage strategies. Table 1 lists the expected outcome of each water-sharing dispute according to each of the explanations discussed above.

United States v. Mexico, Upper Rio Grande, 1894–1906

The Rio Grande River Basin originates in Colorado's San Luis Valley and bisects New Mexico until it becomes the international boundary dividing the United States and Mexico six hundred miles downstream from the San Luis Valley. Another twelve hundred miles below the northern tip of the boundary section, the Rio Grande empties into the Gulf of Mexico. The Upper Basin of the Rio Grande includes the San Luis Valley, much of New Mexico and the Juarez–El Paso Valley, which spans eighty-five miles from the southern end of the Mesilla Valley in New Mexico to Fort Quitman, Texas. This case commences with the protests of Mexico City (the Mexican central government) against diversions of water from the Upper Rio Grande at multiple locations in southern Colorado and northern New Mexico. It ends with the 1906 signing of a bilateral water-sharing treaty, which provides Mexico with sixty thousand acre-feet of water from a major water-storage dam at Elephant Butte, New Mexico (completed in 1916)—a facility which makes water supplies in southern New Mexico, northwestern Texas, and northeastern Mexico less insecure. Acting as a de facto "ally" of Mexico City subsequent to the latter country's internationalization of what might otherwise have remained a local U.S. controversy, the state of Texas played a crucial role obtaining Washington's (the U.S. federal government's) embargo in late 1896 against increases in water diversions in southern Colorado and northern

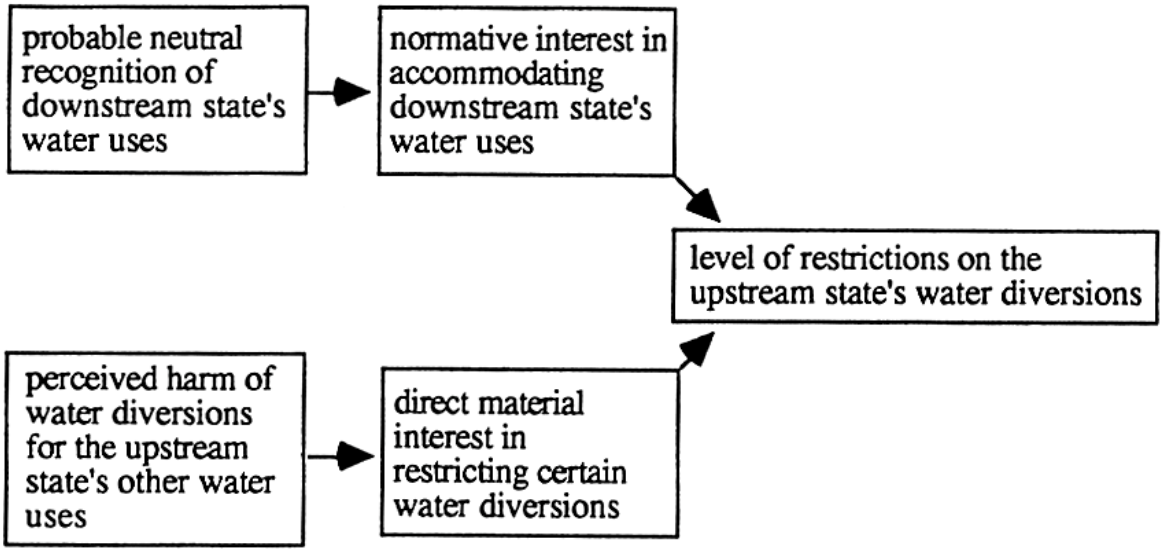

Figure 1: The Political Origins of Self-Imposed Constraints on Upstream-State Water Diversions

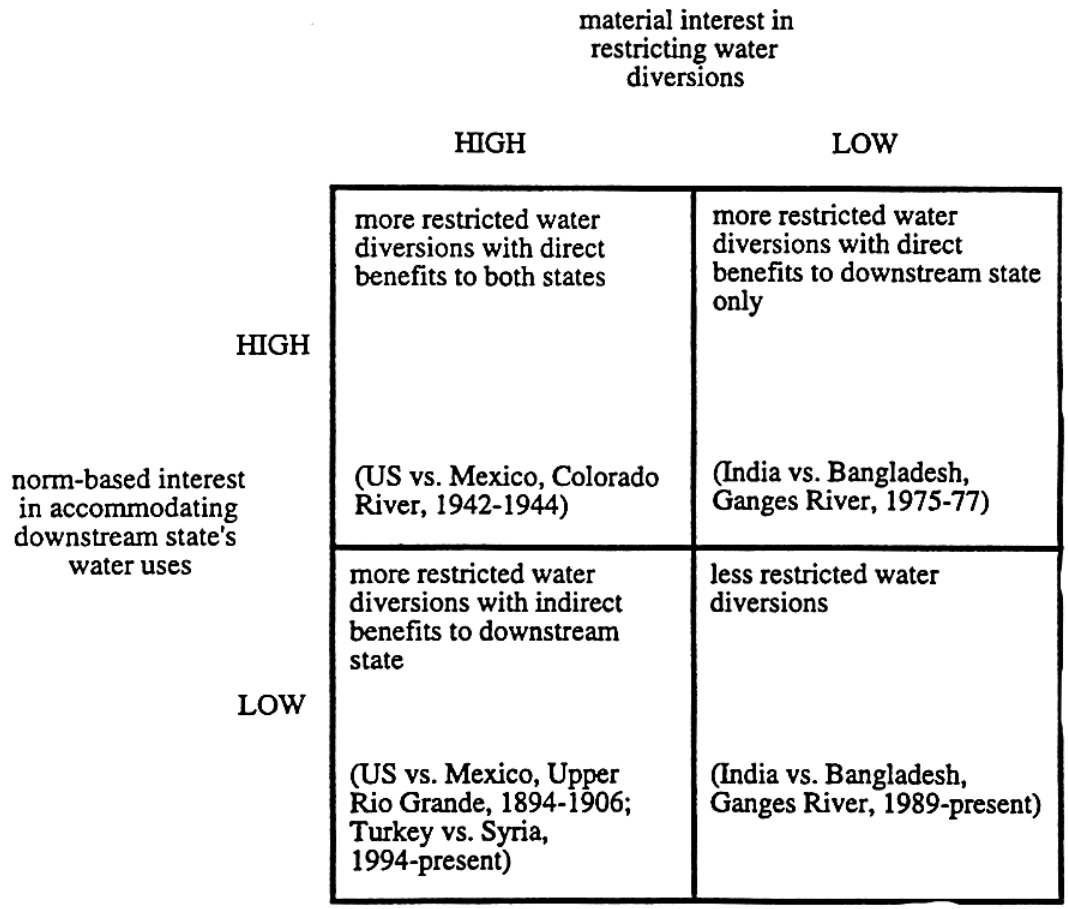

Figure 2: How Upstream Norm-based and material interests relate to restrictions on Upstream-state Water Diversions

	U.S.–Mex, Upper Rio Grande (1894–1906): R*	U.S.–Mex, Colorado River (1942–1944): R	Indo–Bang, Ganges River (1975–1977): R	Indo–Bang, Ganges River (1989–present): LR	Turko–Syria, Euphrates River (1994–present): R
Downstream-state military power	LR	LR	LR	LR	LR
Downstream-state alliance military leverage	LR	LR	LR	R	LR
Downstream-state riverine leverage	LR	LR	LR	LR	LR
Downstream-state economic leverage	LR	LR	LR	R	LR
Norm-based interest in accommodating down-stream-state water uses	LR	R	R	LR	LR
Material interest in restricting upstream-state water diversions	R	R	LR	LR	R

Table 1: Competing Explanations of Water-Sharing Controversies

*R = more restricted water diversions; LR = less restricted water diversions

New Mexico. Furthermore, working with representatives of southern New Mexico's water users, Texas helped ensure the ratification of the 1906 accord.

Material Linkages

In this period, Mexico had few viable military allies and minimal military leverage against the United States. Additionally, it lacked the means of, and interest in, building hydrological facilities to exploit its upstream position on major Lower Rio Grande tributaries (as it did during the Colorado River controversy) to obtain more Upper Rio Grande water. Also, even though the 1893 depression initially dried up many domestic sources of revenue for major projects, a proliferation of individual water diversions on U.S. territory and U.S. water users' acquisition of British capital for larger-scale hydrological facilities went forward without Mexico City's approval.[36] Finally, trade never emerged as a salient issue in the context of bilateral water-sharing relations during this period. At any rate, Mexico City did not appear to exchange access to its markets for guarantees of U.S. water, as dollar-denominated U.S. exports to Mexico (a small fraction of total U.S. exports) remained between 50 and 55 percent of total bilateral trade during the 1900–1906 period.[37]

Material Interest of U.S. Upper Rio Grande Water Users in Restricting Water Diversions

Evidently, Mexico City did not need to use material linkages to get Washington to restrict water diversions in southern Colorado and northern New Mexico. By the mid-1890s, the proliferation of individual water diversions in these areas had, in conjunction with lack of adequate water-storage facilities and endemic drought, caused water shortages in the New Mexico's Mesilla Valley and in the international Juarez–El Paso Valley. That the farming population of El Paso County had declined from about 10,000 to 2,000 in the 1890s and the population of Ciudad Juarez municipality had fallen from about 20,000 to 29,000 in 1881–1883 to 8,780 in 1895 testifies to the local severity of periodic water shortages).[38] The resident U.S. Army engineer of El Paso, who had attributed these water shortages in the late 1880s to the Rio Grande Basin's endemic flood–drought cycles, began ascribing them to upstream diversions around 1890.[39] In the "summer" season (April–September) of 1891, a flood year, 1,608,000 acre-feet of water passed El Paso, compared to 714,000 at Del Norte, Colorado, and 1,046,000 at Embudo, New Mexico. On the other hand, during this same season in the drought year of 1894, 317,000 acre-feet of water reached El Paso, compared to 382,000 at Del Norte.[40]

During the latter drought, Mexico City protested U.S. disregard for Mexico's prior water uses, refusal to build an international dam at El Paso, and violations of United States–Mexican treaty prohibitions against impairing the navigability of the Rio Grande. Initially, the U.S. State Department referred Mexico City's complaint to the U.S. Justice Department, whose attorney general declared, in what has become known as the Harmon Doctrine (or the doctrine of absolute territorial sovereignty), that states can use water passing through their sovereign territory as they see fit, and found that U.S. water diversions had not affected navigation, argued to begin far below the El Paso area.[41] On the other hand, in the person of the resident U.S. Army engineer at El Paso, Texas, water users came to exercise a predominant influence over the pre-1900 position of Washington (as embodied in officials of the executive-branch departments of interior, justice, state and war) on the need for an international treaty and limitations on water diversions above Juarez–El Paso Valley.[42]

In 1896, unsatisfied with the Harmon doctrine as a basis for resolving the United States–Mexican water-sharing dispute, the U.S. State Department appointed the International Boundary Commission (created in 1889 and implemented in 1894 to address problems relating to the shifting bed in the river's boundary section) to report on the problem of dividing the waters of the Rio Grande waters between the two countries. Based on a U.S. Geological Survey streamflow investigation, the commission report rebuked the attorney general's 1895 opinion. It confirmed pre-existing water uses in the Juarez–El Paso Valley (about sixty thousand acre-feet on the Mexican side) and attributed water scarcity there and in

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[36] On the role of the 1893 depression in transforming the U.S.-owned Rio Grande Dam and Irrigation Company into the British-owned Rio Grande Irrigation and Land Company, Ltd., see Littlefield (1987, 44–49).

[37] U.S. exports to Mexico climbed from 35 to 58 million dollars, contributed to a mean favorable trade balance of about 3.28 million dollars, and averaged less than 3 percent of total U.S. exports (itself a small portion of U.S. national income) for the first six years of the twentieth century. See Lorey (1990, 366). For one author's comments about the high tariff barriers guarding the United States market, which constituted Mexico's only feasible market for vegetables and fruits, see Timm (1941, 211).

[38] Mexican figures cited in Lorey (1990, 34). U.S. figures come by way of U.S. Department of State (1903, 366).

[39] See Hundley (1966, 21).

[40] Del Norte, Embudo, and El Paso have contributing runoff areas of fourteen hundred, seven thousand, and thirty thousand acre-feet, respectively. On the streamflow estimates for Del Norte and Embudo (missing for 1894), see U.S. Department of State (1903, 300–03). On revised streamflow estimates for El Paso, see International Boundary Commission (1943, 49).

[41] See Clark (1987, 91).

[42] On El Paso's early resistance to water diversions interfering with a proposed international dam at El Paso, see Littlefield (1987, 53–61, 128–29, 134).

southern New Mexico to diversions further upstream, especially in Colorado's San Luis Valley. The commission also recommended a treaty obligating the U.S. government to build an international dam at El Paso and an embargo prohibiting the construction of any major hydrological facilities which would impound water meant for the former dam. Armed with the Boundary Commission's findings and recommendations, the Department of the Interior refused to grant new rights-of-way for diversion dams and irrigation canals in New Mexico. Furthermore, based on a Department of War finding of the river's limited navigability above El Paso, the Department of Justice sued to enjoin construction of a large private dam at Elephant Butte, New Mexico (125 miles north of El Paso).[43]

While interests in the state of Texas played a significant role in generating support for preventing new upstream water diversions, they could not muster the majority support in Congress necessary to obtain government funding for an international dam at El Paso. Tapping into nationalistic sentiment during the presidential election of 1900, interests in the U.S. Territory of New Mexico opposed the El Paso dam proposal based on the fact that the dam would submerge cultivated land in the Mesilla Valley without yielding any benefits to New Mexico. These interests signaled to Congress that concluding a treaty predicated on the existence of this dam did not reflect the sentiments of a majority of U.S. water users on the Upper Rio Grande. Larger public opposition to the idea of an El Paso dam, stemming from arguments that the dam would benefit U.S. speculators in Mexican land (akin to "rent-seeking" interests), indicated to Texas the political necessity of finding alternative means of securing the Juarez–El Paso Valley's collective water uses.[44] Mexico City renewed its protests in 1904, during which time drought had exacted an even worse toll on the Juarez–El Paso Valley's water supply. Estimated streamflow passing El Paso during the 1904 April–September growing period measured 18,400 acre-feet, down from 1,003,860 acre-feet in 1903, and estimated irrigated acreage in the valley dropped from a previous high of 42,700 (18,000 on the U.S. side, 24,700 on the Mexican side) in 1896 to all-time low of 500 (294 on the U.S. side, 204 on the Mexican side) in 1904.[45]

The 1902 Reclamation Act provided the statutory means by which the U.S. federal government sought to resolve the inter-state and transboundary water-sharing disputes. Ironically, the U.S. Reclamation Service's 1904 report, which called for building a federal water-storage facility near the controversial Elephant Butte site in order to furnish 600,000 acre-feet of water annually for 180,000 acres (110,000 acres in New Mexico, 20,000 acres in Texas above El Paso, and 50,000 acres below El Paso on both sides of the river), laid the basis for a compromise uniting Texas and New Mexico behind both the federal embargo on new water diversions in Colorado and the 1906 United States–Mexican water-sharing accord. In return for the approving the Leasburg (Diversion) Dam in southern New Mexico, Texas obtained a dam which would also store enough water to meet the collective water uses of the Juarez–El Paso Valley. Even though it had an interest in formally limiting Mexico's share of the total Upper Rio Grande water supply to some degree, the state of Texas did not want the treaty share reduced too drastically. With the support of the U.S. State Department and Reclamation Service, Texas cited U.S. international obligations to Mexico in order to obtain a Congressional appropriation of funds to defray the proportionate costs to Texas of building the Elephant Butte Dam for Mexico's water uses (approximately $1 million, one-seventh of the dam's total cost, corresponding to storage of 85,714 acre-feet less an estimated 30 percent conveyance loss).[46] Even more importantly, were it not for the fact that the U.S. side of the Juarez–El Paso Valley lacked the means to secure its own water uses at the expense the Mexican side's water uses (that is, both sides drew much of their water from the same point on the river's main stem), Mexico City would have faced almost insurmountable political odds in obtaining a formal allocation of even sixty thousand acre-feet.

United States v. Mexico, Colorado River, 1942–1944

Beginning from its headwaters in Wyoming and Colorado and draining about 242,000 square miles in the United States and 2,000 square miles in Mexico, the Colorado River travels 1,400 miles to Mexico's Gulf of California, or Sea of Cortez, an estuary of the Pacific Ocean. This case begins with the completion in 1942 of the All-American Canal, which for the first time gave U.S. water users the capacity to divert most or all of the water in the Colorado River within the territorial confines of the United States. It ends in 1944, with the signing of a water-sharing treaty cov-

[43] See Hundley (1966, 21–28) and Clark (1987, 90–94). On the specific content of the boundary commission's report, see U.S. Department of State (1903, 280, 296, 298, 300).

[44] On opposition to the international dam, see Clark (1987, 91–92, 95–96) and Littlefield (1987, 60, 128–29, 201).

[45] These streamflow and irrigated acreage estimates are found in International Boundary Commission (1943, 49) and (1942, 98). Streamflow passing El Paso in April–September was less than that of 1894 for half of the 1895–1904 period. During the summer growing seasons of the drought years 1896, 1899, 1900, and 1902, 233,740 acre-feet of water, 39,140 acre-feet, 154,970 acre-feet, and 32,563 acre-feet, respectively, reached El Paso.

[46] A detailed chronology of specific events is provided in Littlefield (1987, 126–44, 185–202).

ering the Tijuana River, Colorado River, and Lower Rio Grande. By this date, norm-based interest in accommodating Mexico's contemporaneous water uses and material interest among the majority of U.S. States in the Colorado River Basins in restricting water diversions into the All-American Canal combined to support increasing Washington's offer of water to Mexico from 750,000 acre-feet to 1.5 to 1.7 million acre-feet. A perceived increase in the probability of Mexico gaining neutral recognition of its expanding water uses, via international arbitration proceedings, promoted the norm-based interest in expediting an accord which accommodated Mexico's contemporaneous Colorado River water uses (about 1.5 million acre-feet). Also, fear that faster-developing California would acquire priority rights to water temporarily unstorable in their respective territories stimulated the material interest of five out of the seven U.S. Colorado River Basin States in restricting California's use of the All-American Canal and affiliated works.

Material Linkages

In this case, Mexico City either could not make, or failed to make, effective material linkages to gain more Colorado River water. Clearly, the efforts of California's Imperial Irrigation District to build the All-American Canal in place of the Alamo Canal, which traversed the Mexican side of the Imperial Valley before returning to the U.S. side, induced Mexico City to secure better legal safeguards for its Colorado River water uses. While explicitly worded communication with representatives of the U.S. Basin States conveyed Washington's desire to eliminate water-sharing controversies as a potential stumbling block to consolidating Latin American support for U.S. regional political initiatives, Mexico City appealed to Washington's preference for hemispheric defense coordination only in order to increase its access to U.S. markets in agriculture and petroleum. While not clearly intended to give Mexico City additional bargaining chips in other issue-areas, Mexico's 1938 expropriation of U.S.-owned oil production assets clearly had counterproductive results: this action increased political opposition within the United States, not only to giving Mexico a more generous offer of Colorado River water, but also to increasing imports of Mexican products.[47] Furthermore, the Great Depression gave impetus to the creation of the Public Works Administration under the aegis of the 1933 National Industrial Recovery Act, which provided funding for major infrastructural works.[48]

Mexico's only explicit material linkage strategy—flexing its upstream muscle on important Lower Rio Grande tributaries in order to gain Colorado River water—had ambiguous results. Mexico City, which had stepped up its efforts to develop the local economies of Mexico's long-neglected border regions in 1926, openly threatened in 1937 to use its proposed water-storage and diversion facilities on Lower Rio Grande tributaries in order to gain U.S. concessions on the Colorado River. While this linkage appears to have had some effect in winning Texas's ultimate support for the idea of a transboundary water-sharing accord covering the Colorado River and Lower Rio Grande, in the short term, it appeared to have encouraged Texas water users to neutralize this strategy. These threats mobilized water users on the U.S. side of the Lower Rio Grande Valley to obtain Congressional appropriations for the Valley Gravity Canal and Storage Project, an ostensible flood-control scheme (storage capacity: four hundred thousand acre-feet) which, if constructed, would have tapped the main channel of the Rio Grande above the intake of the furthest upstream Mexican water-diversion facility and purportedly threatened one million acres of Mexican land in that valley.[49]

U.S. Norm-Based Interest in Accommodating Mexico's Colorado River Water Uses

Until early 1943, the norm-based interest in accommodating Mexico's existing water uses exerted a weak hold over most Colorado River water users in the United States. Mexico's accelerated efforts to develop its agricultural lands in the Lower Colorado and Lower Rio Grande river basins and the U.S. objective of consolidating Latin American support for the Good Neighbor Policy and U.S. hemispheric defense-coordination initiatives did prompt Washington, DC to resume bilateral negotiations in 1937 (eight years after the termination of a brief, but inconclusive, opening round in 1929). However, these factors also unified the seven Colorado River Basin States in opposition to increasing the official U.S. guarantee of Colorado River water to Mexico beyond the 1929 figure of 750,000 acre-feet. In 1938, to project their collective material interest, the seven

[47] On the mixed results of Washington's appeal to the Good Neighbor Policy and hemispheric defense-coordination in order to win the 1944 approval of U.S. States of the Colorado Basin for an offer to Mexico of 1.5 million acre-feet of water, see Hundley (1966, 79, 81, 87, 100, 112, 159). On Mexico City's linkages between increased access to U.S. oil and agricultural markets and its ability to contribute to hemispheric defense and pay compensation for expropriated U.S. property and Washington, D.C.'s counterlinkages between adequate Mexican compensation for expropriated U.S. property and U.S. willingness to conclude a trade agreement with Mexico, see U.S. Department of State (1961, 1040, 1045–47, 1056), (1962, 372, 375, 380, 384), (1963, 499–500, 503–04), and (1965, 592).

[48] On the role of the Public Works Administration and Reconstruction Finance Corporation in stimulating and hindering the construction of hydrological works on the Rio Grande, see Littlefield (1987, 289, 294, 306–07, 311–12).

[49] See Hundley (1966, 76–77, 93–96, 122).

Basin States formed a Committee of Fourteen (composed of two delegates from each state). Meeting in their capacity as committee members, the States quashed a 1939 State Department-backed Interior Department study which estimated Mexico's future water uses at 1.6 million acre-feet, and rejected a 1942 State Department proposal to raise the minimum U.S. offer to 1.5 million acre-feet.[50]

As conveyed by the U.S. State Department, Mexico City's indication that it would seek arbitration of the water-sharing controversy arguably had the greatest impact on getting the U.S. Basin States to approve a water-sharing accord satisfactory to Mexico. Ironically, while never explicitly precluding arbitration in its private communications with Washington, Mexico City privately harbored serious reservations about arbitration. On the other hand, Washington doubted that Mexico City would win a favorable award, but nonetheless felt obligated to accept arbitration and the results thereof under the terms of the 1929 Inter-American Arbitration Treaty.[51] The State Department's view that the Basin States' adamant stance against granting Mexico more than 750,000 acre-feet of water might precipitate a breakdown in negotiations and initiation of arbitration proceedings resonated forcefully within the Committee of Fourteen, especially in light of the fact that, by 1943, Mexico's existing Colorado River water uses had reached 1.5 million acre-feet and Mexico City had scaled its demands down from 4.5 million to 2 million acre-feet.[52] Arbitration would have signaled deviation from the procedural norm, which U.S. Supreme Court opinions and acts of concluding inter-state water-sharing compacts helped legitimate, of trying to curb litigation of inter-state water-sharing disputes. Secondly, arbitral recognition of Mexico's existing water uses would have indicated a dissonance between offering Mexico substantially less than this amount and the substantive norm, also given shape through various U.S. court decisions and inter-state agreements, of recognizing existing water uses as "equitable" where they promote established economies.[53] Of course, with the State Department's stress on the possibility of an arbitral award recognizing the expected growth of Mexico's water uses up to the time of arbitration, the Basin States perceived the potential effect of arbitration, albeit unevenly distributed, on their immediate material interests.[54]

Material Interest of U.S. Colorado River Water Users in Restricting Water Diversions

Apart from norm-based interests in accommodating Mexico's water uses, a majority of Basin States had its own material interest to restricting water diversions into the All-American Canal. Alone and as part of a larger (mostly) California project to expand water-storage capacity to over 30 million acre-feet (a two-year supply) and expand water-diversion capacity to about 11,800 cusecs (cubic feet per second), or 8,500,000 acre-feet per annum, the All-American Canal alarmed other U.S. states.[55] They feared that the U.S. Supreme Court's 1922 decision in *Wyoming v. Colorado* (which applied the rule of prior appropriation to inter-state streams) would legitimate California's efforts to appropriate most of the Colorado River Basin's total water supply. Accordingly, these

[50] Ibid., 79–93, 106–10.

[51] Mexico City raised the possibility of resort to arbitration as a way of expediting negotiations, but a couple years earlier had, given the United States' refusal to recognize (until 1963) a 1911 arbitral award granting Mexico territorial jurisdiction over the El Chamizal tract of land in the boundary section of the Upper Rio Grande, virtually dismissed the probability of getting the United States to comply with an award favoring Mexico. In contrast, even though Washington discounted the Mexico's chances of getting a favorable arbitral award, it still touted the U.S. obligation to arbitrate in order to gain the Basin States' approval of a water-sharing accord. See U.S. Department of State (1965, 593–96, 602, 605, 618–19, 628) and Hundley (1966, 98–99, 104, 123–25, 128, 146–47, 149).

[52] As a U.S. State Department official acknowledged in response to a challenge from one of California's congressional representatives, Washington's figures for Mexico's water uses during 1928–1944 came from the Mexican Section of the International Boundary Commission. See U.S. Senate (1945, 952–53, 962–64). On Mexico City's reduction in its demand to two million acre-feet, see Hundley (1966, 104, 122).

[53] By the mid-1940s, U.S. Supreme Court decisions containing observations on the inefficacy of litigation included *New York v. New Jersey* (1921), *Colorado v. Kansas* (1943), and *Nebraska v. Wyoming* (1945). Supreme Court rulings recognizing present water uses in inter-state disputes include *New Jersey v. New York* (1931) and *Nebraska v. Wyoming* (1945). The negotiation of the 1922 Colorado River Compact also reflected a desire to avoid litigation. See Jain, Jacob, and Jain, et al. (1971, 113–14, 160–63). Another author notes that U.S. Supreme Court-appointed Special Water Master postponed hearings on *Texas v. New Mexico* (filed in 1935) according to progress on a permanent Rio Grande Compact (concluded in 1938). See Littlefield (1987, 294, 296, 300, 301, 307, 312).

[54] On the State Department's belief that precedent favored recognition of present water uses and emphasis on the possibility of an arbitral award recognizing water uses existing at the time of initiation of arbitration proceedings, see Hundley (1966, 106, 111, 123–24, 128, 135–36); U.S. Department of State (1967, 1363).

[55] Hoover Dam/Lake Mead, which began storing water in 1935, has a "live" storage capacity (i.e., usable for hydropower production) of approximately 27.935 million acre-feet, and Parker Dam/Lake Havasu, which began storing water in 1938, has a usable storage capacity of 688,000 acre-feet. Its main connection to Lake Matthews completed in 1940, the Colorado River Aqueduct's original diversion capacity from Lake Havasu totaled 1,500 cusecs. Fully completed in 1942, the All-American Canal has a diversion capacity of 10,000 cusecs (8,500 for the Imperial Irrigation District and 1,500 to the Coachella Valley County Water District) below Pilot Knob. These figures come from U.S. Department of the Interior (1947, 22, 27) and Matthew ([1953?], 19–20).

States conditioned approval of Congressional appropriations on the Colorado River Compact. This compact apportioned the total water supply (then overestimated at 18 million acre feet) as follows: 7.5 million acre feet for the designated Upper Basin States (Colorado, New Mexico, Wyoming, and Utah); 7.5 million acre feet, plus the right to use up to 1 million acre feet of surplus water, for the Lower Basin States (Arizona, California, and Nevada); and the remaining unappropriated surplus water for Mexico in the event of a future treaty. However, the compact's failure to provide for a formal suballocation of the Lower Basin's quota among that Basin's States caused Arizona until 1944 to withhold ratification of the compact and 1928 Boulder Canyon Project Act, which appropriated project funds in return for California's agreement to limit itself to 4.4 million acre feet of water.[56]

Given California's planned hydrological activities, Arizona's refusal to approve the 1922 compact fueled the Upper Basin States' apprehension that they might lose claim to the 7.5 million acre-feet of water. By the early 1930s, California, hoping to appropriate most of the one million acre-feet of surplus water reserved for the Lower Basin, had signed contracts for delivery of 5.362 million acre-feet of water. Ironically, California's Imperial Irrigation District (IID) planned to use the Pilot Knob power plant and wasteway to release up to two million acre-feet of water per year from the All-American Canal into Mexico's Alamo Canal until the IID could recoup the unpaid portion of Mexico's share of the latter canal's operating and maintenance costs. In the interim, California wanted Mexico's permanent water rights limited to 750,000 acre-feet in order to ensure the priority status of contracts for the extra 750,000 acre-feet that would otherwise go to Mexico as part of a treaty giving the latter country 1.5 million acre-feet. The Upper Basin States believed that if fastest-developing California obtained an additional 962,000 acre-feet of water (the difference between 5.362 and 4.4 million acre-feet), Arizona, not then bound by the terms the 1922 compact, would invade the quota of the most laggardly Upper Basin States. Moreover, without an international water-sharing accord delimiting Mexico's water uses, the Upper Basin States, who heeded the State Department's warnings about arbitration, exhibited the greatest concern about the possibility of neutral recognition of Mexico's uses of the two million acre-feet of water which Upper Basin territory could not yet impound. Thus, these upstream States, who wanted to get Arizona's approval of the 1922 compact and a treaty stabilizing Mexico's water share at 1.5 million acre-feet, supported the retention of U.S. federal government (specifically, the Bureau of Reclamation) control over the All-American Canal and Pilot Knob works.[57]

The State of Arizona had concurrent material interests in restricting the Imperial Irrigation District's uses of the All-American Canal. First, representatives of Arizona feared that Arizona's topography would not allow it to increase its water diversions from the main channel of the Colorado River above Hoover Dam before California had built all of its planned water-storage and diversion facilities. Also, it did not fully trust Imperial Irrigation District to use the Imperial (Diversion) Dam cum All-American Canal to safeguard Arizona's furthest downstream water diversions (whose point of intake had been moved five miles upstream from Laguna Dam to Imperial Dam upon completion of the latter). Thus, Arizona readily supported the Upper Basin States' effort to maintain U.S. federal governmental control over the Imperial Dam and affiliated facilities.[58] At a Commi ttee of Fourteen meeting in early 1943, all Basin States except Nevada and California supported the State Department's offer of 1.5 million acre feet for Mexico and approved a New Mexican resolution urging the U.S. Bureau of Reclamation to retain control of all facilities which delivered water to Mexico. The results of this meeting paved the way for negotiations leading to the 1944 accord, which gave Mexico 1.5 to 1.7 million acre-feet "from any and all sources of water" (including five hundred thousand acre-feet until 1980 through the All-American Canal, which the accord placed under the U.S. federal government's operational jurisdiction).[59]

India v. Bangladesh, Ganges River, 1975–1977

The main stem of the Ganges River, bound by the Himalayas in the north and Vindhyas in the south, begins and wends its way 1,450 kilometers through the state of Uttar Pradesh in India, 445 kilometers in the state of Bihar, and 520 kilometers in the state of West Bengal, where the river bifurcates into the Bhagirathi-Hooghly distributary, which serves the Port of Calcutta, and the Padma River, which enters Bangladesh to join the Brahmaputra River before emptying into the Bay of Bengal. In 1971, the Indian government completed a barrage at Farakka, located between the Bihar–West Bengal border and the India–Bangladesh boundary. This barrage comprised the first part of a larger project ostensibly intended to

[56] See Meyers (1967, 504–05, 514).

[57] On California's desire to limit Mexico's water share and the Upper Basin states' fear of Lower Basin and Mexican invasion of their quota, see Hundley (1966, 81–82, 105, 113, 118, 128–29).

[58] On Arizona's lawsuits designed to force court-apportionment of water among the Lower Basin states and that state's opposition to California's control over Lower Basin projects, see Hundley (1966, 60–62, 82–85, 128–31) and Meyers (1967, 511–23).

[59] See Meyers (1967, 544); Hundley (1966, 102–36).

flush accumulated silt from the Bhagirathi-Hooghly and thus preserve Calcutta Port. This case begins four years later, when Bangladesh protested the commissioning of the second half of the project: a canal capable of diverting 40,000 cubic feet per second from the Farakka Barrage, on the main stem of the Ganges River, to the Jangipur Barrage on the Bhagirathi-Hooghly. This period concludes with the 1977 signing of a Ganges River water-sharing accord (in effect beginning in 1978), which restricts water diversions into the Farakka Feeder Canal to approximately half of the canal's capacity during the period of lowest flow—approximately 55,000 cubic meters per second.

In this case, one can attribute greater restrictions on water diversions into the Farakka Feeder Canal mostly to the strength of India's norm-based interest in accommodating the Bangladesh's water uses. By hearing and acting upon the protests of Dhaka (the Bangladeshi negotiating authorities), the UN General Assembly made itself available as a potential source of neutral recognition of the downstream country's water uses. In addition, the admittedly conciliatory tone of Dhaka's statements in the United Nations' 1977 Water Conference at Mar de la Plata may have signaled to New Delhi (the Indian negotiating authorities) that Dhaka was more clearly willing to depoliticize, and thus compromise on, the Farakka Barrage issue. Because unrestricted water diversions (40,000 cubic feet per second) at Farakka Barrage came at the expense of Bangladesh's water uses only, New Delhi implicitly ensured majority support for the 1977 bilateral accord by allowing unauthorized water diversions in the more politically powerful upstream Indian States of Uttar Pradesh and Bihar.

Material Linkages

In this period, Dhaka found material linkages unavailable or undesirable. The role of India's armed forces in defeating Pakistan and liberating Bangladesh prior to this period testifies to Bangladesh's military inferiority relative to India. In addition, even though Dhaka established diplomatic and military ties with both Pakistan and the People's Republic of China in 1975, their recognition and support of Bangladesh did not suffice to prevent India from failing to restrict water diversions into the canal at Farakka for the next two dry seasons (1976 and 1977). Indeed, Moscow's support for New Delhi since 1971, the neutrality of Washington vis-à-vis both the water-sharing dispute in 1976 and subcontinental disputes from 1977–1979, and India's underground detonation of a nuclear bomb in 1974 suggest a relaxation of external strictures on India's water-sharing behavior in 1977.[60] Downstream from India on the Brahmaputra River as well, Bangladesh possesses minimal hydrological leverage over India's Ganges River behavior. Although Dhaka enjoyed potential leverage in the context of New Delhi's overt preferences for a trans-Bangladesh link canal for augmenting the water supplies of the Ganges River with water drawn from the Brahmaputra River, Dhaka denounced this proposal as contrary to Bangladesh's territorial sovereignty.[61] Indo-Bangladeshi trade relations did not evidently factor into Dhaka's bargaining strategy in the water-sharing issue-area. In spite of India's less cooperative water-sharing behavior during 1975–1977, Indian exports to Bangladesh, as denominated in Bangladeshi currency, climbed from 86 percent of total bilateral trade in 1973–1974 to 99 percent in 1976–1977.[62]

Dhaka's scattershot approach to protesting unrestricted water diversions into the Farakka Barrage during the 1976 dry season serves as the clearest manifestation of Bangladesh's lack of real material leverage over India's Ganges River water-sharing behavior. In fact, an eight-month period of coups and countercoups in Bangladesh following the assassination of that country's independence leader in August 1975 had considerably worsened relations with New Delhi. While New Delhi and Dhaka maintained the facade of bilateral negotiations during 1976, the trading of accusations of bad faith in joint data-collection efforts, as well as a massive march of Bangladeshi citizens to the Indo-Bangladesh boundary in protest of water diversions at the Farakka Barrage, soured these discussions. Exploiting India's desire to avoid outside intervention in Indian Subcontinental affairs, Bangladesh officials broached the water-sharing dispute within a number of multilateral forums, including the United Nations General Assembly.[63]

India's Norm-Based Interest in Accommodating Bangladesh's Ganges River Water Uses

More than any other tactic for drawing world attention to its dispute with India, Dhaka's use of the more neutral forums of the UN General Assembly and the United Nation's Mar de la Plata Water Conference hastened the conclusion of a bilateral water-sharing accord. First, Dhaka's successful effort to get the 31st Session of the UN General Assembly to assign the

[60] On India's wide-ranging involvement in liberating Bangladesh, see Singh (1987, 20–24). On New Delhi's ties with Moscow and detonation of a nuclear bomb counterbalancing Islamabad's ties with Beijing and Washington, and Islamabad's and Beijing's ties with Dhaka following the Bangladeshi coup of 1975, see Wriggins (1992, 107–09, 113, 121). On the brief neutrality of the U.S. government toward subcontinental rivalries in the late 1970s, see Vernon Marston Hewitt (1992, 67, 71).

[61] On Dhaka's objections to the proposed Brahmaputra–Ganges link canal, see Begum (1988, 197–98, 216–17).

[62] See Bangladesh Bureau of Statistics (1979, 272).

[63] See Begum (1988, 111–12, 125, 128–55) and Singh (1987, 101–11).

water-sharing dispute to the Special Political Committee in September 1976 produced a mutually acceptable consensus statement (which members of the Non-Aligned Movement brokered) two months later. By leaving open the option for either party to report on the progress of bilateral negotiations to the Thirty-Second General Assembly Session, this statement increased the probability of neutral recognition of Bangladesh's water uses if negotiations were to reach a second impasse. Secondly, the official General Assembly resolution adopting the consensus statement also incorporated language whereby India agreed to accept a third-party settlement (e.g., mediation, conciliation, arbitration, adjudication, etc.) if bilateral negotiations failed. In addition, by the time of the United Nations' Mar de la Plata Water Conference in March 1977, Dhaka had toned down its more extreme rhetoric about the rights of downstream countries, to the point of skirting reference to the effects of water diversions at Farakka Barrage altogether. This calculated avoidance lent itself to a wider perception that India's own actions, not Dhaka's refusal to compromise, were impeding the negotiations.[64] Having successfully exploited the growing domestic perception that the Congress (I) government had unduly risked the credibility of India's policy of negotiating differences with other subcontinental countries on a strictly bilateral basis, the Janata Party, which won a majority of seats in Indian Parliament in the March 1977 elections, found it politically exigent to demonstrate New Delhi's ability to expedite a bilateral settlement of the Ganges River dispute.[65]

In April 1977, New Delhi and Dhaka reached an understanding whereby Bangladesh would receive 34,500 out of the 55,000 cubic feet per second in the last 10-day period of April, the most critical time of the low-flow season, thus resolving one of the most nettlesome aspects of conflict (both countries approved an accord applying to a five-month period—January 1 to May 31—in November 1977). India's direct material interest in restricting dry-season water diversions into the Farakka Feeder Canal, located below the intake points for the vast majority of other Ganges River water diversions within India, barely existed. However, the nature of opposition to the accord within the state of West Bengal reveals the likely source of majority political support. Prior to the accord's signing, the state of West Bengal complained that the canal at Farakka had to bear the entire burden of the accord because "secret" water diversions, alleged to total twenty thousand to thirty thousand cubic feet per second, in the upstream States of Uttar Pradesh and Bihar had reduced the volume of streamflow reaching Farakka.[66] Because most of the seats in the two "Hindi-Belt" States (the most populous), but few in West Bengal, went to the Janata Party in 1977 and Indira Gandhi's Congress (I) Party in 1980, both majority parties would have found it more politically feasible to concentrate the overall redistributive burden of the accord at Farakka.[67]

India v. Bangladesh, Ganges River, 1989–Present

This case starts following the expiration of the last extension of the 1977 accord after the end of the 1988 dry season. Evidence suggests that, since 1989, India has maintained the minimum treaty-scheduled water allocation to the Farakka Canal at the expense of Bangladesh's water allocation. In part reflective of the domestic political weakness of successive Bangladesh governments, Dhaka's increasingly hard-line attitude on joint water-use issues, as manifested in its failure to make real progress towards agreeing on a long-term solution to the water-shortage problem and reversion to extremist rhetoric against the Farakka Barrage, has weakened India's norm-based interest in accommodating Bangladesh's treaty-scheduled water allocation. Furthermore, increased diversions of Ganges River water upstream of the Farakka Barrage continue to reduce the flow of water reaching the Barrage, increasing the political untenability of preserving the downstream state's water supply.

Material Linkages

By 1988, certain political and economic developments in the Subcontinent should have widened Dhaka's opportunities for making more effective material linkages. The waning of Sino–Soviet rivalry (which culminating in the estimated demobilization of one million Chinese troops on the Soviet border) and Pakistan's acquisition of nuclear weapons-making capabilities should have added to Bangladesh's potential military leverage over India's water-sharing behavior in this period.[68] Even though attributable to Bangladesh's urgent need for greater flood

[64] On a Bangladeshi account of its actions in the United Nations from September 1976 to March 1977, see Abbas (1982, 54–75).

[65] See Singh (1987, 56) and Begum (1988, 170–72).

[66] On the April 1977 understanding, see Abbas (1982, 79, 91). On West Bengal's complaints about unchecked water diversions in Uttar Pradesh and Bihar, see Begum (1988, 183, 186).

[67] With 65, 68.1, and 21.5 percent of the vote, the Janata Party won, respectively, 52 of 54 seats in Bihar, all 85 seats in Uttar Pradesh, and only 16 out of 42 seats in West Bengal, respectively, in 1977, while with 36.4, 35.9, and 36.5 percent of the vote, Congress (I) Party won, respectively, 30 of 54 seats in Bihar, 51 of 85 seats in Uttar Pradesh, but only 4 out of 41 seats in West Bengal. See Myron Weiner (1978, 68, 71) and Weiner (1983, 152–53).

[68] On the ramifications of the Sino–Soviet rapprochement for India's security position, see Hewitt (1992, 77). References to Pakistan's development of nuclear bomb-making capabilities come from Hagerty (1995–1996: 94–96).

control during the monsoon season, Dhaka's 1988 proposal for a Regional Water Authority involving China (half the length of the Brahmaputra River runs through Tibet) has not precluded a desire to gain vicarious riverine leverage against India. Given the sacrality of India's policy of conducting foreign relations bilaterally and perceptions of Chinese designs on territory in the Indian border States of Arunchal Pradesh and Assam, New Delhi has greeted this proposal coldly.[69] Dhaka has not shown any proclivity to exchange market access for water: between 1985 and 1992, Indian exports, as denominated in Bangladeshi currency, accounted for roughly 97 to 98 percent of total bilateral trade.[70] Moreover, its concerns about sovereignty paramount, Dhaka has publicly refused to trade Ganges River water for access to Bangladeshi transit routes connecting India's seven isolated northeastern States with the ports of Calcutta in India and Chittagong in Bangladesh.[71]

Decline of India's Norm-Based Interest in Accommodating Bangladesh's Ganges River Water Uses

With India lacking adequate water-storage capacity on its Ganges River tributaries, New Delhi did not intend for the 1977 accord and subsequent renewals thereof (in 1982 and 1985) to lay the groundwork for a permanent water-sharing agreement. The accords essentially conditioned India's water-diversion restrictions on Dhaka's cooperation in finding a mutually acceptable scheme for augmenting both countries' overall water supplies. Furthermore, extremely reluctant to assent to Bangladesh's proposal for building large joint water-storage projects on Nepalese territory as a way of increasing both countries' dependable water supplies, New Delhi wanted Dhaka to accept the Indian proposal for a Brahmaputra–Ganges link canal. India's assumed restrictions on Farakka Canal water diversions seem attributable at least in part to New Delhi's perception that Dhaka, which publicly spurned the Indian link-canal proposal as an encroachment on Bangladesh's territorial sovereignty, had expressed a private willingness to consider a domestic version of the link-canal proposal.[72]

By the latter half of the 1980s, however, while the Rajiv Gandhi government perceived itself as having assumed a considerable political risk by agreeing to include Nepal in tripartite discussions of joint water-storage plans, New Delhi believed that Dhaka had more clearly reverted to a less compromising stance on the former's proposals for joint water-augmentation schemes. The downstream state's perceived hard-line position, largely corresponding to the political weakness of Bangladesh's leaders, subsumes Dhaka's less ambiguous refusal to support even the internal Brahmaputra–Padma (Ganges) link-canal proposal as well as that government's public blaming of the Farakka Barrage for both dry-season shortages and monsoon-season surfeit of Ganges River water.[73]

Domestic normative and material concerns have also coincided to lessen the political feasibility of maintaining the treaty allocation of water to Bangladesh. The level of material interest among India's Ganges River water users in restricting water diversions at Farakka did not rise relative to that of the previous period. Given India's continued lack of adequate Ganges River water-storage capacity, majority political support for the 1977 accord arose from the fact that during the treaty-designated five-month dry season, the citizens of the more politically powerful upstream States of Uttar Pradesh and Bihar did not have to moderate their own water diversions. In fact, plans to build a dam at Kanpur in Uttar Pradesh portend even greater reductions in the water supply reaching West Bengal. Consonant with domestically applied principles of "equitable" apportionment of water supplies, New Delhi has implicitly refused to reduce water diversions into the Farakka Canal below 20,000 cubic feet per second to compensate Bangladesh for diversions further upstream; thus, Bangladesh has borne an increasingly larger burden of water shortages at Farakka.[74]

While classification of Indian streamflow data makes ascertaining the actual quantitative allocations of water at the Farakka Barrage difficult, Table 2 provides a clear, albeit crude, indication that Bangladesh's 1977 treaty allocation has suffered considerable diminution since the end of the 1988 dry season. Over the course of the 1975–1988 period, Bangladesh received more than the treaty-scheduled allocations (approximately 60 percent of the water supply reaching Farakka Barrage, which can divert up to 72 percent of the mean water supply during the most critical shortage period—April 21 to April 30). Con

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[69] On proposals for a Regional Water Authority, see Upreti (1993, 145). Discussion of Sino–Indian territorial disputes is found in Hewitt (1992, 43–45).

[70] On Bangladesh's trade balance with India, see Bangladesh Bureau of Statistics (1986, 552), (1989, 324), and (1995, 291).

[71] On the potential for bilateral economic gains by trading water for rights-of-transit across Bangladeshi territory, see Ben Crow, Alan Lindquist, and David Wilson (1995, 221–25), Zubrzycki (1996, 7), and "Water Pressure" (1996, 33–34).

[72] On the view that Bangladesh had developed a more positive attitude toward India's link-canal proposal, see Singh (1987, 143). On Dhaka's consideration of an internal link canal and New Delhi's favorable attitude toward it, see Crow, Lindquist, and Wilson (1995, 186, 193, 197–98, 201, 203, 208).

[73] Ibid., 198–99, 205–08, 210–17.

[74] On developments in Uttar Pradesh and the reduction in water supply at Farakka Barrage, see Kamaluddin and Sarkar (1995, 29). On the way in which India's post-1988 method of making the allocations of water to West Bengal and Bangladesh provides uncertain protection of the latter's water uses, see Kaye (1989, 22).

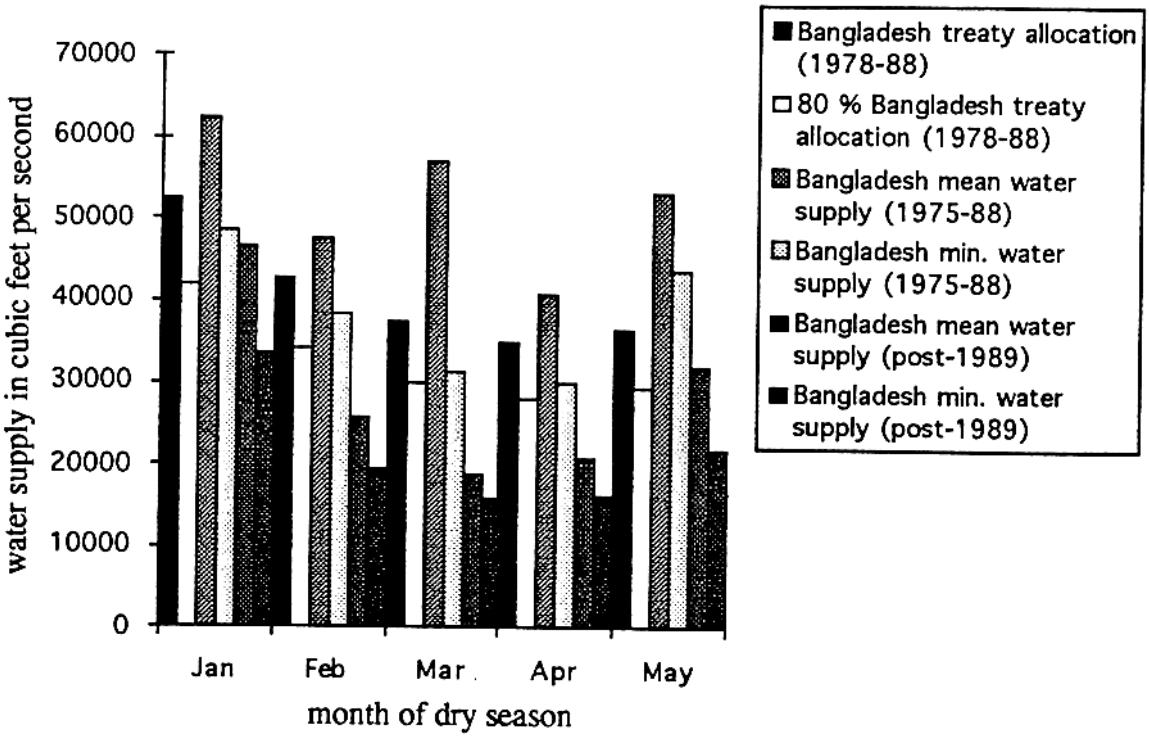

Table 2: Bangladesh's Ganges River Water Supply with and without Formal Restrictions on Water Diversions at Farakka, India (in cusecs)

Sources: Begum (1988, 183), Singh (1987, 169), Islam (1987, 182), Bangladesh Bureau of Statistics (1990, 1991, 1993, 1995).

versely, this figure also shows that for part of the period specified in this case study, the mean Ganges River water supply in Bangladesh fell below the treaty-scheduled allocation for every month of the dry season. Some Indian sources even corroborate Dhaka's figure, suggesting that the overall water supply now reaching the Farakka Barrage during this period has steadily diminished to about 42,000 cubic feet per second, and that Bangladesh gets a smaller portion of the water reaching Farakka than the 60 percent it was allocated under the 1977 accord.[75]

Turkey v. Syria, Euphrates River, 1994–Present

Originating in the anti-Taurus Mountains of Eastern Turkey, the main channel of the Euphrates River travels 3,000 kilometers, crossing 1,230 kilometers in Turkey (whose territory contributes over 90 percent of the river's total flow), 710 kilometers in Syria, and 1,060 kilometers in Iraq, where it joins the Tigris River before draining into the Persian Gulf. Prior to 1994, Turkish conflict with Syria and Iraq over use of Euphrates River water revolved primarily around temporary water shortages which accompanied the filling of Ataturk Dam. Late 1994 inaugurates a qualitatively new phase of the controversy, as the Urfa Tunnels, which alone can divert one-third of the river, began piping water from Ataturk Dam's reservoir for irrigation; if all Euphrates River irrigation projects come to fruition, the volume of streamflow in Syria and Iraq could drop by 40 and 90 percent, respectively. The level of norm-based interest in accommodating Syria's and Iraq's Euphrates River water uses remains low because of the perceived extremism of the latter countries' anti-dam rhetoric and their refusal to allow independent verification of their actual water requirements. On the other hand, any majority political support for long-term restrictions on water diversions will most likely emanate from competition among different political parties to articulate and champion the material interests of Turkish hydropower consumers.[76]

[75] See Kamaluddin and Sarkar (1995, 29). India appears resistant to reducing diversions of water into the canal at Farakka much below that country's 1977 treaty-allocation of approximately twenty thousand cubic feet per second during the lowest-flow period. Indian sources have indicated that Calcutta Port needs at least this much water to avoid silting damage. See Singh (1987, 131).

[76] The figure on mean streamflow comes from Kolars (1991, 46, 51). For reference to the effect of Turkish projects on Syrian and Iraqi Euphrates River water supplies, see Bulloch and Darwish (1993, 59).

Material Linkages

Thus far, (mostly) Syrian and Iraqi material linkage strategies have not prevented Turkey from completing construction of large multipurpose dams on the Euphrates River. Damascus and Baghdad have opposed Ankara's plan, from its inception, to dam and divert the Euphrates River under the aegis of the Southeast Anatolia Project (Turkish acronym: GAP, which encompasses the provinces of Adiyaman, Diyarbakir, Gaziantep, Mardin, Siirt and Sanliurfa), a larger program which aims to develop the entire economy of Turkey's Euphrates and Tigris River basins. With its relatively larger and more imminent impact in the downstream states, GAP's Euphrates River component has borne the brunt of this opposition. This component features three major multipurpose facilities (those combining water-storage, hydropower, and diversion capabilities): the Ataturk, Birecek, and Karkamis dams. Together with the Keban and Karakaya hydropower dams further upstream, Turkey's five major reservoirs, upon completion, will be able to store 90 billion cubic meters of Euphrates River water (three years' worth of the total volume as measured at Birecek) and will be able to generate as much as 22,500 Gigawatt-hours of energy production (about 20 percent of the country's economically viable hydropower potential). If Turkish authorities maximize water diversions from the Ataturk Dam's diversion facilities, they can irrigate up to 700,000 hectares (64 percent of the maximum total for the Euphrates River Basin). In a significant development, at the end of 1994, Ankara starting diverting water from Ataturk Dam's reservoir into the twin Urfa Tunnels, which have the capacity to divert 328 cubic meters per second (10.29 billion cubic meters per annum) of water for irrigation of the Urfa-Harran and Mardin-Ceylinpinar plains.[77]

Even though Syria and Iraq have a smaller military disadvantage vis-à-vis Turkey than Mexico and Bangladesh have relative to the United States and India respectively, Turkey can still dominate any overt conflict with its downstream neighbors. Despite a bilateral 1990 compact by which Syria and Iraq agreed to divide the water supply available at the Turko-Syrian boundary into 42- and 58-percent shares, respectively, the longer history of mutual mistrust and water-sharing rivalry between Damascus and Baghdad obstructs realization of a military alliance.[78] While evidence indicates that Damascus used its thinly veiled backing of Kurdish PKK terrorism on Turkish territory in exchange for Ankara's 1987 pledge to maintain the flow of water crossing the Turko-Syrian boundary at 500 cubic meters per second (15.768 billion cubic meters per annum), Damascus may now recognize, given that Turkish hydrological facilities are heading towards completion, that supporting terrorism may prove inimical to Syria's interest in preserving its water uses.[79] Syria's upstream position on the Orontes (Asi) River gives Damascus some potential leverage over Turkey's activities in the Euphrates Basin, but Damascus refuses to negotiate over the Orontes for fear of acknowledging Turkish sovereignty over the disputed downstream Hatay Province.[80]

Turkey's economic rationale for seeking the approval of downstream riverine states for the former's hydrological projects has declined considerably over time. With Syrian and Iraqi opposition to Turkish projects constricting the flow of World Bank funding, Ankara has nonetheless demonstrated the ability to marshal indigenous engineering talents, as well as domestic and international sources of funding, to realize its planned expansion in water-storage and diversion capacity. With revenues raised from domestic sources, such as the Housing Fund and Public Participation Fund, in addition to outside donors, including the U.S. Export-Import Bank and a consortium of European banks, Turkey managed to complete the Ataturk Dam in 1991, eight years after commencing construction. In late 1992, Ankara oversaw the initiation of construction of the Birecek Dam (downstream from the Ataturk Dam) with funding from another consortium comprising Turkish, German, Belgian, Austrian and French firms, and in 1996, received pledges of funding from an Austrian-led consortium to build the Karkamis Dam (downstream from the Birecek Dam and 4.5 kilometers north of the Syrian boundary).[81] Also, although Ankara would prefer the lifting of post-Gulf War economic sanctions on Iraq, as these measures have effected a decrease in Turkish imports of Iraqi oil and revenue for serving as the principal entrepôt for Iraqi oil exports, the downstream states cannot easily use

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[77] For information on the technical parameters and economic importance of these dams, see Kolars (1993, 48, 55–59, 61, 71, 92) and Tomanbay (1993, 53–55). On the technical specifications and the Urfa Tunnels, see *The Sanliurfa Tunnels* (n.p., n.d.) and *Studies Relating to Areas to Be Irrigated in the GAP Region* (n.p., n.d.).

[78] On reference to the military imbalance, see *Problems over Water in the Middle East* (1992, 2). On Syro–Iraqi water-sharing rivalry of the 1970s and 1990 agreement, see Gruen (1993, 100).

[79] Ankara has on separate occasions emphasized the deterrent effect of Turkish hydrological facilities, as noted in Beschorner (1992–1993, 37, 42). Another author notes the implied reluctance on the part of Damascus to see disruptions in the flow of water in line with Syria's political and military activity. See Kut (1993, 9).

[80] See Beschorner (1992–1993, 43).

[81] Reference to the Housing and Public Participation Funds comes out of Frey (1993, 34). On economic assistance for the Ataturk, Birecek, and Karkamis projects respectively, see Kolars and Mitchell (1991, 30–32), Gruen (1993, 105), and George (1996, 21).

trade relations as leverage over Turkey's hydrological behavior.[82]

Material Interest of Turkish Euphrates River Water Users in Restricting Water Diversions

Primarily because of the stridency of Syria's and Iraq's opposition to Turkish dams and those countries' refusal to permit verification of their existing water uses, the level of norm-based interest in accommodating Syria's and Iraq's water uses remains low. Presently, Ankara professes to adhere to its informal 1987 pledge to maintain the flow of water reaching the Syrian boundary at 500 cubic meters per second. Ankara has argued that it gave two months' notification of the filling of the Ataturk Dam, and increased releases of water from the upstream Keban and Karakaya hydropower dams in the two months preceding January 1990 (up to 768 cumecs) in order to attain 509-cumec mean water supply over the initial four-month period (November 1989–February 1990). Turkish government sources also point out that the demands of maintaining the five hundred-cubic-meters-per-second requirement resulted in holding the volume of water in the Ataturk Dam down at fifteen billion cubic meters, an amount less by twenty-seven billion cubic meters (the dam needs at least twenty-nine billion cubic meters—an amount equivalent to dead storage capacity—to begin generating hydropower) of the maximum volume impoundable in the twenty-month period following January 1990. Officials in Ankara also point out that Birecek Dam's function as an "after-bay," or regulation, dam helps to smooth out variations in the amount of water released from Ataturk Dam for hydropower production.[83]

Whether the level of norm-based interest in accommodating Syria's and Iraq's Euphrates River water uses (at least at the five hundred-cubic-meters-per-second level) will rise as Turkey builds the water-diversion facilities and affiliated irrigation and drainage projects of the Southeast Anatolia Project remains uncertain. Two factors dampen this norm-based interest. Ankara perceives the immoderate opposition of Damascus and Baghdad to Turkish hydrological facilities, expressed in the downstream states' attempt to isolate Turkey in the Arab world and Syria's efforts to tie agreement with Israel over the Golan Heights issue with a Euphrates River agreement, as offering little grounds for reaching a permanent settlement in the spirit of compromise.[84] Secondly, Damascus and Baghdad, while demanding 700 cubic meters per second at the Syrian boundary and citing ultimate Euphrates River water-consumption requirements of 11.30 and 23.00 billion cubic meters per annum (approximately 4.30 billion cubic meters in excess of the river's total volume), respectively, have spurned Ankara's request for a joint survey of Syrian and Iraqi lands in order to determine more precisely the distribution of economically irrigable land among the three countries. Ankara expresses the difficulty in a democratic country of justifying arbitrary and idiosyncratic criteria for limiting requisite uses of a common water source.[85]

The most likely source of majority political support for a permanent Euphrates River water-sharing accord will emanate from a higher level of material interest in restricting diversions of water from the Ataturk, Birecek, and Karkamis dams. The nonfederal structure of Turkey's democratic political institutions, the cultural legacy of a strong central administration dating from Ottoman times, prevents the emergence of internal water-sharing disputes along provincial lines. By coordinating the construction and operation of hydrological projects in the Euphrates and Tigris river basins, the Prime Ministry-affiliated Southeast Anatolia Project Regional Development Administration can develop Southeast Anatolia's water resources without regard to the transprovincial distribution of expanded water-storage and diversion capacity.[86]

However, central administration of major Euphrates River projects cannot eliminate the potential for domestic water-sharing disputes related to the tradeoff between water diversions (mainly for irrigators) and hydropower production (mainly for industrial and municipal consumers) inherent in the multipurpose technological character of these dams. According to the Southeast Anatolia Project's own Master Plan, maximizing Turkey's irrigated acreage in the Euphrates region would leave firm water discharge from the Karkamis Dam on the Turko-Syrian boundary at only 348 cubic meters per second. On the other hand, limiting the expansion of irrigated agriculture to no more than the Urfa-Harran and Mardin-Ceylanpinar plains would not only permit an

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[82] See Beschorner (1992–1993, 38).

[83] See Ministry of Foreign Affairs (Turkey) (1995, 16–21). On potential for lack of bureaucratic coordination between the State Hydraulic Works and Foreign Ministry to exacerbate water-sharing conflicts, see Turan (1993, 155).

[84] On Syrian and Iraqi efforts to isolate Turkey diplomatically within the Arab world and the Golan Heights–Euphrates River linkage, see Gruen (1993, 105) and Kohen (1996).

[85] Since a 1992 tripartite meeting, Damascus and Baghdad have demanded seven hundred cubic meters per second, as noted in Gruen (1993, 104). On the Syrian and Iraqi water-consumption figures, the Turkish approach to determining water requirements, and the political difficulty of justifying arbitrary differences between the three countries' methods of determination, see Ministry of Foreign Affairs (Turkey) (1995, 13, 29, 35–38).

[86] On strong state traditions in Turkey, see Heper (1990, 321–23). The president of the Regional Development Administration notes in effect that technical designs, not provincial subdivisions, govern the priorities, construction programs, and beneficiaries of the Southeast Anatolia Project. See Unver, President of the Southeast Anatolia Project Regional Development Administration (1995).

increase in energy from a low of 17,500 Gigawatt-hours associated with the maximum irrigation scenario to 22,500 Gigawatt-hours, but also leave a water releases from Karkamis Dam at 557 cubic meters per second, enough to satisfy Turkey's now informal 500-cubic-meters-per-second commitment.[87] As of late 1994, the Ataturk Dam was producing almost 5,500 Gigawatt-hours of energy, up from 1,700 in 1991. As implied in grumblings from local business interests in Southeast Anatolia that the now-completed Euphrates River projects are providing benefits mostly to extra-regional populations, consumers of Ataturk Dam's hydropower reside in the more industrialized, populous, and politically influential western areas of Turkey. Given Turkey's desire to curtail its dependence on imported oil and expand industrial production, advocating restrictions on water diversions (especially into the Urfa Tunnel) constitutes a latent, but formidable, basis for vote getting among highly competitive Turkish political parties.[88]

Policy Implications

The theoretical and empirical accounts presented above imply certain general courses of actions which downstream states, especially weaker ones, can pursue in trying to get upstream states to limit water diversions and accommodate the former countries' existing water uses. They also suggest particular actions which Bangladesh and Syria can take in getting India and Turkey, respectively, to reach formal and lasting water-sharing settlements.

General

First, to raise the level of the upstream state's norm-based interest in accommodating the weaker downstream state's existing water uses,

1. downstream states need to refrain from using coercive linkage strategies and engaging in indiscriminate or blanket verbal condemnation of the upstream state's efforts to develop the latter's portion of the transboundary watercourse
2. downstream states can arrange for independent verification of its water uses

To the latter end, Western governments, especially the United States, need to make neutral recognition of the downstream state's water uses easier by making more vigorous efforts to finalize and ratify the provisional UN Law of the Non-Navigable Uses of International Waterways, especially the provisions pertaining to the obligation not to cause appreciable harm, the general obligation to cooperate, and regular exchange of data and information.[89]

Secondly, to raise the level of the upstream state's material interest in restricting its water diversions,

1. downstream states need to focus the content of their protests on the size and location of the upstream state's water diversions
2. downstream states can better direct their protests against those specific water diversions expected to present material detriment to a majority, or at least a substantial minority, of transboundary water users in the upstream state.

Case-Specific

India v. Bangladesh, Ganges River

First, to increase the level of India's norm-based interest in re-accommodating Bangladesh's pre-1989 water uses,

1. Bangladesh needs to avoid condemning India's Farakka Barrage as the cause of both water shortages and flooding in the Padma fork of the Ganges River
2. Bangladesh can support its own version of the Brahmaputra–Ganges link-canal proposal

India does not intend to dismantle the Farakka Barrage, so unreasoned condemnation of it indicates to India that Bangladesh does not intend to compromise on water-sharing issues, and lessens political support for limiting water diversions into the Barrage's feeder canal to accommodate Bangladesh's water supply. By funding feasibility studies on the internal link-canal proposal, as it has done in the past, the World Bank can play a role in helping Bangladesh to demonstrate its commitment to find a mutually acceptable long-term solution to the dry-season water shortage problem.[90]

On the other hand, to increase the level of material interest in restricting the overall quantity of Indian water diversions, Bangladesh can ally with the Indian state of West Bengal.[91] Two routes to forging this alliance make sense:

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[87] On GAP's depiction of the tradeoff between hydropower production and irrigation priorities, see Kolars (1993, 70–71).

[88] The figures on Ataturk Dam's hydropower production are noted in *The Ataturk Dam and Hydroelectric Power Plant (HEPP)* (n.d.). On the local dissatisfaction with the direction of the flow of benefits, see "The War That Cannot Speak Its Name" (1996, 15). On Turkey's high level of dependence on energy imports, see Kolars (1993, 54–62).

[89] For a general listing of the provisions of this draft code, see Gleick (1992, 20–23).

[90] On support of foreign technical expertise and a $1 million World Bank loan for study of this proposal, see Crow, Lindquist, and Wilson (1995, 186, 199).

[91] As Ben Crow writes:

> The shadow of Farakka has for long hidden the common interests of West Bengal and Bangladesh in the maintenance of dry season flows and the mitigation of flood flows in the

1. Bangladesh can support the Farakka Barrage as a salient location for measuring and allocating both West Bengal's and Bangladesh's respective shares of water according to the 1977 treaty schedules
2. Bangladesh has the ability to back West Bengal's efforts to restrict planned increases in water-storage and diversion capacity in Uttar Pradesh

Turkey v. Syria, Euphrates River

To bolster Turkey's norm-based interest in accommodating their present water uses,

1. Syria and Iraq need to arrange for independent verification of their water-use requirements
2. Syria and Iraq cannot continue to use Kurdish terrorism and diplomatic isolation of Turkey in the Arab World against the Southeast Anatolia Project
3. Syria and Iraq must refrain from engaging in blanket condemnation of the Southeast Anatolia Project

At the same time, to raise the level of material interest in restricting Turkish water diversions, Syria and Iraq have the ability to reinforce the political power of Turkish hydropower consumers (who benefit from releases of water downstream) relative to irrigators (who benefit mainly from diversions of water away from the river) by accepting Turkish offers to sell hydropower.[92]

Conclusion

A number of significant international water-sharing controversies show the comprehensive quality of the weakness of some downstream states: these states frequently lack not only the military and economic means to ensure adequate protection of their water uses, but also the requisite political skills and willingness to use what few sources of material leverage they do have access to in an productive manner.[93]

While the democratic and usually liberal political attributes of certain powerful upstream states provide a fertile ground in which to reach a lasting settlement, but these attributes do not suffice to induce the upstream states to cooperate. The actions of the downstream state serve a critical function in achieving a cooperative resolution of the transboundary water-sharing disputes examined in this paper. The downstream state's act of protesting usually suffices to initiate negotiations with the end of reaching a formal water-sharing arrangement, but the use of sweeping, uncompromising, and unreasoned rhetoric against the upstream state's hydrological activities generally leaves the more powerful upstream state's negotiators unmoved at least and more intransigent (for domestic political reasons) at most. Offering some hope for a respite from talk of "water wars," the efforts of weaker downstream states to appeal to norms of compromise whose application has clear precedent within the upstream state and exploit transboundary water-sharing conflicts among the upstream state's own water users can aid the former states in attaining a relatively more secure co-existence between their water uses and the hydrological activities of the more powerful upstream neighbors.

Ganges. It may now seem possible for discussions between the governments of West Bengal and Bangladesh to strengthen the voice of lower riparian states (Crow, Lindquist, and Wilson 1995, 238).

[92] On the Turkish government's offer to sell electricity to both Syria and Iraq in 1987, see Tekeli (1990, 214). Turkey also has indicated preparations for linking its power system with networks in Egypt, Iraq, Jordan, and Syria for more efficient production, as reported in Holman (1994).

[93] At least two separate arguments hold that those serving the interests of Mexico and Bangladesh in negotiating water-sharing arrangements with the United States and India, respectively, did not have the requisite technical or economic resources necessary to make a fully accurate determination of the downstream countries' water requirements. In the case of the Upper Rio Grande, see Kroeber (1983, 152–54). On the Ganges River case, see Begum (1988, 113–20).

REFERENCES

Abbas, B. M. 1982. *The Ganges Water Dispute*. Dhaka: Vikas Publishing House Pvt.

American Society of International Law. 1990. The non-navigational uses of international watercourses. Proceedings of the Eighty-fourth Annual Meeting of the American Society of International Law, March 28–31: 228–35.

Axelrod, Robert. 1970. *Conflict of Interest*. Chicago, IL: Markham Publishing.

———. 1984. *The Evolution of Cooperation*. New York: Basic Books.

Axelrod, Robert, and Robert O. Keohane. 1986. Achieving cooperation under anarchy: Strategies and institutions. In *Cooperation under Anarchy,* edited by Kenneth Oye. Princeton, NJ: Princeton University Press: 226–54.

Bangladesh Bureau of Statistics. 1979. *Statistical Yearbook of Bangladesh 1979*. Dhaka: Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh.

———.1986. *Statistical Yearbook of Bangladesh 1986*. Dhaka: Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh.

———.1989. *Statistical Yearbook of Bangladesh 1989*. Dhaka: Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh.

———.1990. *Statistical Yearbook of Bangladesh 1990*. Dhaka: Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh.

———.1991. *Statistical Yearbook of Bangladesh 1991*. Dhaka: Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh.

———.1993. *Statistical Yearbook of Bangladesh 1993*. Dhaka: Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh.

———.1995. *Statistical Yearbook of Bangladesh 1994*. Dhaka: Bangladesh Bureau of Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh.

Begum, Khurshida. 1988. *Tension over the Farakka Barrage: A Techno–Political Tangle in South Asia.* Stuttgart, Germany: Steiner Verlag Weisbaden GMBH.

Beschorner, Natasha. 1992–1993. Water and instability in the Middle East. *Adelphi Paper* no. 273. London: Brassey's for International Institute for Strategic Studies (winter).

Bulloch, John, and Abel Darwish. 1993. *Water Wars: Coming Conflicts in the Middle East.* London: Gollancz.

Clark, Ira G. 1987. *Water in New Mexico: A History of Its Management and Use*. Albuquerque: University of New Mexico.

Crow, Ben, Alan Lindquist, and David Wilson. 1995. *Sharing the Ganges: The Politics and Technology of River Development.* New Delhi, Thousand Oaks, London: Sage Publications.

Frey, Frederick W. 1993. Power, conflict, and cooperation. *Research & Exploration* 9 (November): 18–37.

Friman, H. Richard. 1993. Side-payments versus security cards: Domestic bargaining tactics in international economic negotiations. *International Organization* 47 (summer): 353–86.

George, Alan. 1996. Syria and Iraq threaten anti-European action. *Middle East* 255 (April): 1.

Getches, David H. 1990. *Water Law in a Nutshell*. St. Paul, MN: West Publishing.

Glaser, Charles L. 1994–1995. Realists as optimists: Cooperation as self-help. *International Security* 19, no. 3 (winter): 50–90.

Gleick, Peter H. 1992. Water and conflict. *Occasional Paper Series of the Project on Environmental Change and Acute Conflict,* no. 1. Cambridge, MA: International Security Studies Program, American Academy of Arts and Sciences; Toronto, Canada: Peace and Conflict Studies Program, University College, University of Toronto (September).

Grieco, Joseph. 1988. Anarchy and the limits of international cooperation: A realist critique of the newest liberal institutionalism. *International Organization* 42 (summer): 485–507.

———. 1993. Understanding the problem of international cooperation: The limits of neoliberal institutionalism and the future of realist theory. In *Neorealism and Neoliberalism*, edited by David A. Baldwin. New York: Columbia University Press, 301–38.

Gruen, George E. 1993. Recent negotiations over the waters of the Euphrates and Tigris. In *Proceedings of the International Symposium on Water Resources in the Middle East: Policy and Institutional Aspects.* Urbana, IL: International Water Resources Association (October 24–27): 100–108. International Water Resources Association: n.p.

Hagerty, Devin. 1995–1996. Nuclear deterrence in South Asia: The 1990 Indo–Pakistani crisis. *International Security* 20, no. 3 (winter): 79–114.

Heper, Metin. 1990. The state, political party, and society in post-1983 Turkey. *Government and Opposition* 25 (summer): 321–33.

Hewitt, Vernon Marston. 1992. *The International Politics of South Asia.* Manchester, England: Manchester University Press.

Holman, Richard L. 1994. Mideast power grid prepared. *The Wall Street Journal* (May 10): sect. A14.

Homer-Dixon, Thomas F. 1991. On the threshold: Environmental changes as causes of acute conflict. *International Security* 16, no. 2: 76–116.

Hundley, Norris. 1966. *Dividing the Waters: A Century of Controversy between the United States and Mexico.* Berkeley, CA: University of California Press.

International Boundary Commission. 1942. *Water Bulletin,* no. 12.

———. 1943. *Water Bulletin,* no. 13.

Islam, M. Rafiqul. 1987. *Ganges Water Dispute: Its International Legal Aspects*. Dhaka: University Press.

Jain, S. N., Alice Jacob, and Subash C. Jain. 1971. *Interstate Water Disputes in India: Suggestions for Reform of Law.* Bombay: N. M. Tripathi Pvt.

Kamaluddin, S., and Jayanta Sarkar. 1995. Just not enough: Delhi, Dhaka try to share the Ganges' limited waters. *Far Eastern Economic Review* 20 (July): 29.

Kaye, Lincoln. 1989. Resources and rights: Rivalries hamper Indo–Bangladesh water-sharing. *Far Eastern Economic Review* 2 (February): 22.

Kershner, Isabel. 1990. Talking water. *Jerusalem Report* 25 (October): 44–45.

Kohen, Sami. 1996. A thirsty Syria may make Turkey's water price of peace. *Christian Science Monitor* (January 9): 1.

Kolars, John F. 1993. Problems of international river management: The case of the Euphrates. In *Middle East Water Issues: From the Euphrates to the Nile*, edited by Asit K. Biswas. Oxford: Oxford University Press, 44–94.

Kolars, John F., and William Mitchell. 1991. *The Euphrates River and the Southeast Anatolia Development Project*. Carbondale and Edwardsville, IL: Southern Illinois University Press.

Kroeber, Clifton. 1983. *Man, Land, and Water: Mexico's Farmlands Irrigation Policies 1885–1911*. Berkeley, CA: University of California Press.

Kut, Gün. 1993. Burning waters: The hydropolitics of the Euphrates and Tigris. *New Perspectives on Turkey* 9 (fall): 1–17.

Lake, David A. 1988. *Power, Protection, and Free Trade: International Sources of U.S. Commercial Strategy, 1887–1939.* Ithaca, NY: Cornell University Press.

LeMarquand, David G. 1977. *International Rivers: The Politics of Cooperation*. Vancouver: Westwater Research Centre, University of British Columbia.

Levy, Marc. 1995. Is the environment a national security issue? *International Security* 20, no. 2: 35–62.

Littlefield, Douglas. 1987. Interstate water conflicts, compromises, and compacts: The Rio Grande, 1880–1938. Ph.D. Diss., University of California, Los Angeles.

Lorey, David E., ed. 1990. *United States–Mexico Border Statistics since 1900*. Los Angeles, CA: UCLA Latin American Center Publications.

Lowi, Miriam R. 1993. *Water and Power: The Politics of a Scarce Resource in the Jordan River Basin*. Cambridge: Cambridge University Press.

Matthew, Raymond. [1953?.] Use of Colorado River water in California. *ASCE Convention Preprint Paper,* no. 84: n.p.

Mayer, Frederick W. 1992. Managing domestic differences in international negotiations: The strategic use of internal side payments. *International Organization* 46, no. 4 (autumn): 793–818.

Meyers, Charles J. 1967. The Colorado Basin. In *The Law of International Drainage Basins*, edited by A. H. Garretson, R. D. Hayton, and C. J. Olmstead. Dobbs Ferry, NY: Oceana Publications, 486–607.

Ministry of Foreign Affairs (Turkey). 1995. *Water issues between Turkey, Syria, and Iraq.* Department of Regional and Transboundary Waters (January): n.p.

Naff, Thomas. 1993. Water: "That peculiar substance." *Research & Exploration* 9 (November): 6–17.

Naff, Thomas, and Ruth C. Matson, eds. 1984. *Water in the Middle East: Conflict or Cooperation?* Boulder, CO: Westview Press.

Olson, Mancur. 1971. *The Logic of Collective Action: Public Goods and the Theory of Groups.* Cambridge, MA: Harvard University Press.

Ostrom, Elinor. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action.* Cambridge: Cambridge University Press.

Owen, John M. 1994. How liberalism produces democratic peace. *International Security* 19, no. 2: 87–125.

Problems over Water in the Middle East. 1992. Background Brief, United Kingdom: Foreign and Commonwealth Office (January).

Putnam, Robert D. 1988. Diplomacy and domestic politics: The logic of two-level games. *International Organization* 42 (summer): 427–60.

Rao, K. L. 1975. *India's Water Wealth.* New Delhi: Orient Longman.

Ramaswami, V. 1978. Law relating to equitable apportionment of the waters of interstate rivers in India. *Journal of the Indian Law Institute* 20, no. 4: 505–34.

Richards, Alan. 1993. Strengthening markets to build peace: The general case, illustrated by the example of agriculture and water. Paper prepared for Project on Middle East Multilateral Talks, Center for International Relations, University of California, Los Angeles, and the Institute on Global Conflict and Cooperation, University of California (System) (May).

Rogers, Peter. 1993. The value of cooperation in resolving international river basin disputes. *National Resources Forum* 17, no. 2: 117–31.

Rosecrance, Richard. 1986. *The Rise of the Trading State: Commerce and Conquest in the Modern World.* New York: Basic Books.

Schoppa, Leonard J. 1993. Two-level games and bargaining outcomes: Domestic bargaining tactics in international economic negotiations—Why *Gaiatsu* Succeeds in Japan in Some Cases But Not Others. *International Organization* 47 (summer): 353–410.

Singh, Kuldeep. 1987. *India and Bangladesh.* Delhi: Ammol Publications.

Stein, Arthur A. 1990. *Why Nations Cooperate: Circumstance and Choice in International Relations*. Ithaca, NY: Cornell University Press.

Studies Relating to Areas to Be Irrigated in the GAP Region. n.d. Southeast Anatolia Project Regional Development Administration (Turkey): n.p.

Tekeli, Sahim. 1990. Turkey seeks reconciliation for the water issue induced by the Southeastern Anatolia Project (GAP). *Water International* 15, no. 4: 206–16.

The Ataturk Dam and Hydroelectric Power Plant (HEPP). n.d. Southeast Anatolia Project Regional Development Administration (Turkey): n.p.

The Sanliurfa Tunnels. n.d. Southeast Anatolia Project Regional Development Administration (Turkey): n.p.

The war that cannot speak its name. 1996. *The Economist* (June 8–14): 15.

Timm, Charles A. 1941. *The International Boundary Commission, United States and Mexico.* Austin: University of Texas.

Tomanbay, Mehmet. 1993. Sharing the Euphrates. *Research & Exploration* 9, (November): 53–61.

Turan, Ilter. 1993. Politics of water and the role of regional organizations. *Proceedings of the International Symposium on Water Resources in the Middle East: Policy and Institutional Aspects.* Urbana, IL: International Water Resources Association (October 24–27): 152–58.

Unver, Olcay, President of the Southeast Anatolia Project Regional Development Administration. 1995. Interview by author, July 17, in Ankara, Turkey. Tape recording.

Upreti, B. C. 1993. *The Politics of Himalayan River Waters: An Analysis of the River Water Issues of Nepal, India, and Bangladesh*. Jaipur and New Delhi: Nirala Publications.

U.S. Department of State. 1903. *Proceedings of the International (Water) Boundary Commission, United States and Mexico, Treaties of 1884 and 1889: Equitable Distribution of the Waters of the Rio Grande Volume II.* Washington, D.C.

_____. 1961. *Foreign Relations of the United States 1940 Volume V*. Washington, D.C.

_____. 1962. *Foreign Relations of the United States 1941 Volume VII*. Washington, D.C.

_____. 1963. *Foreign Relations of the United States 1942 Volume VI*. Washington, D.C.

_____. 1965. *Foreign Relations of the United States 1943 Volume VI*. Washington, D.C.

_____. 1967. *Foreign Relations of the United States 1944 Volume VII*. Washington, D.C.

U.S. Department of the Interior. 1947. Geological survey. *Surface Water Supply of the United States, 1946: Part 9, Colorado River Basin*. Washington, D.C.: U.S. Government Printing Office.

U.S. Senate. 1945. Committee on Foreign Relations. *Hearings on Water Treaty with Mexico*. 79th Cong., 1st sess. Washington, D.C.

Waltz, Kenneth N. 1979. *Theory of International Politics*. New York: Random House.

Water in the Middle East. 1995–1996. *The Economist* (December 23–January 5): 53–55.

Water pressure. 1996. The *Economist* (September 7–13): 33–34.

Weiner, Myron. 1978. *India at the Polls: The Parliamentary Elections of 1977*. Washington, D.C.: American Enterprise Institute for Public Policy Research.

————. 1983. *India at the Polls, 1980: A Study of the Parliamentary Elections*. Washington, D.C.: American Enterprise Institute for Public Policy Research.

Wishart, David. 1990. The breakdown of the Johnston negotiations over the Jordan waters. *Middle East Studies* 26 (October): 536–46.

Wriggins, W. Howard. 1992. South Asian regional politics: Asymmetrical balance or one-state dominance? In *Dynamics of Regional Politics: Four Systems on the Pacific Rim*, edited by W. Howard Wriggins, F. Gregory Gause III, Terrence Lyons, and Evelyn Colbert. New York: Columbia University Press, 89–132.

Zaman, Munir. 1982. Institutional and legal framework for cooperation between Bangladesh and India on shared water resources. In *River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4–10, 1981,* edited by Munir Zaman, Asit K. Biswas, Amjad H. Khan, and Ainun Nishat. Dublin: Tycooly International Publishing: 185–94.

Zubrzycki, John. 1996. Where water is not their own. *Christian Science Monitor* (March 27): 7.

THE POLITICAL ECONOMY OF INTERNATIONAL ENVIRONMENTAL COOPERATION

CONCLUSION

Richard Ackermann

The papers collected here all deal with various aspects of government policy, in particular restructuring of entrenched economic and political institutions: inefficient industrial systems with distorted incentives in China; forest management systems in Chile which are difficult to change; fishery regimes which have been dominated by an old-fashioned perspective which leaves little room for efficient solutions; inefficient agricultural systems in Central Asia, where cotton monoculture is the rural equivalent of heavy industry "monoculture" in other parts of the Former Soviet Union and in China; and political relationships in which meaningful deals depend on expanding the scope of alternatives available to the parties to reach an agreement. The papers discussed here propose a range of solutions to particular aspects of these government policies. It is interesting to ask: "How relevant are the problems identified, and the solutions proposed?"

What determines policy relevance? Three concepts are important: (i) objectives; (ii) priorities; and (iii) implementation. Focusing policy papers too much on objectives – on long-range goals – risks being too abstract. Focusing too much on implementation risks proposing inefficient solutions. Policy relevance depends very much on the shrewd identification of priorities – the next steps that can lead to longer-term efficient solutions and that can be implemented with the scarce institutional capacity available (for example, the proposal in Chunghua Rich's paper accommodates the weak existing administrative capacity). Priorities are agreed through a political process, so policy relevance means saying something about "how do you decide what to do?" and not so much "what should you do?"

It is certainly important that objectives be clearly identified, and that indicators are available to measure progress against those objectives. However, there is generally a broad popular consensus about social objectives, even if politicians tend more to pay lip service to them than to make the tough decisions necessary to adhere to them. It is equally important that there be a realistic implementation plan. Unfortunately, a common mistake (especially by development assistance agencies) is to jump straight to "implementable solutions," disregarding whether these solutions are in fact real priorities which contribute toward achieving important objectives. In many cases, taking no action may be better than taking an inappropriate action just because it's "implementable." A few thoughts about objectives, priorities and implementation.

Objectives. One can broadly distinguish three kinds of objectives: (i) efficiency; (ii) equity; and (iii) "environment" objectives. All of the papers collected here touch to varying

degrees on these three objectives. Joint implementation (or better, Activities Implemented Jointly) in China, or "out-sourcing" of pollack fishing rights on a competitive commercial basis (rather than reserving exclusive economic zones for national fleets), are examples of "win-win" approaches which bring about environmental (and sometimes equity) benefits at the same time as they achieve efficiency objectives. Similarly, *Hydropolitics* and *Transboundary Water-Sharing* have much to do with equity. One question today is to what extent it is meaningful to try to help re-establish the old way of life for people stranded in desertified areas of Central Asia, and whether resettlement is a meaningful option.

Dealing with equity objectives can be particularly difficult for development institutions like the World Bank. If lending is cut off because countries are corrupt and/or are not performing in important policy areas, it is the poor who usually suffer first. On the other hand, support to corrupt regimes only tends to prolong the agony and delay the difficult political decisions.

Priorities. As mentioned, one test of policy relevance is to what extent the papers offer criteria for identifying and addressing priority issues. For example, if human health is a priority social concern in a country such as China, then how far should environmental policy focus on global and regional (acid rain) issues, rather than local pollution (especially fine particulates) which causes the greatest health damage? Fortunately, these may not be mutually exclusive, as there exist considerable synergies among them – global and regional environmental problems are greatly alleviated through action on local problems. But is it acceptable to first focus on the human health of the population living around the Aral Sea, and leave "social reconstruction" to take place over time in the future? Similarly, what kinds of policies might have the greatest impact in reducing harm to forest resources? How successful are efforts to directly modify forestry regimes likely to be, in contrast to incentives to re-orient agricultural practices or infrastructure development (especially road construction) in potential logging areas?

Reaching consensus on priorities involves a difficult political process – one which engages wide circles of civil society. While this may seem obvious, it is a relatively new concept in development policy work. Policy papers tended to focus much more on the issue to be decided than on the *process to achieve agreement*, and development agencies (such as international financial institutions) often viewed their mandate as one of making a deal with a government agency. Indeed, until less than ten years ago, reports for projects supported by the major multilateral financial institutions were confidential.

Not only have development institutions – and increasingly government agencies – opened up; there is also a growing awareness that development depends on much more than just the efficient use of capital equipment (economic sustainability). It is now also largely accepted that unsustainable natural resource use (depletion of natural capital) will decrease national wealth. However, it is only much more recently that the importance of social sustainability has come to be recognized – not just of developing "human capital" (education and training of individuals), but above all recognizing the contribution of "social capital," the capital embodied in the relationships among people which help societies grow. These social relationships – which are critical for development to succeed – have often been distorted by political systems (such as in the Former Soviet Union, but even within countries, as a study comparing Northern and Southern Italy has shown), and it may require decades for horizontal links within society to (re-)establish themselves. The discussion of recent Western involvement in Post-Soviet Central Asia revealed that outsiders have a very limited capacity to affect improvements; indeed, some such interventions might be outright counter-productive.

So policy-relevant proposals must recognize the limits of what is achievable by virtue of having popular support. International environmental cooperation often focuses on the transfer of financial resources for equipment and capacity building when in fact the local commitment may be oriented in a different direction, and/or prevailing incentives undermine the environmental intervention. For example, joint implementation in China, or rural investments in Central Asia, may achieve little if pricing policies or social customs induce wasteful or damaging resource use.

Implementation. This highlights the importance of taking a fresh look at how policy is implemented. To stand a chance of being successfully implemented, policy proposals need to incorporate considerable flexibility, allow for experimentation, learning-by-doing, and continuous improvement. This may seem like a contradiction-in-terms. But experience shows that polished proposals rarely get implemented the way they were designed. Implementation is the real test: The more a policy recommendation reflects real priorities as perceived by the society or interest group to which it is to apply, and the more implementation options are available, the greater is the likelihood of achieving tangible results. History is the judge.

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