



## GOINGS ON

### Halting the Worldwide 'Race to Fish'—RFF Researchers Evaluating New Zealand's Tradable Quota System for Fisheries as a Model Approach

Today, commercial fishing operations around the world are utilizing ever-larger ships with increasingly sophisticated technology to capture a dwindling resource that cannot be easily regulated. Up until the early 1970s, most fisheries were either completely unmanaged or regulated under command-and-control regulations that failed to check the number of vessels working a given area and encouraged fishermen to work around equipment constraints, such as the size of vessels or type of nets. Since that time, several countries have experimented with approaches based on creating property rights, which limit fishing operations in a given area typically by setting a cap on the total allowable catch (TAC) and allocating the TAC to existing participants based on historical catch.

In the early 1980s New Zealand established one of the first individual transferable quota (ITQ) programs, giving fishermen rights to shares in the total allowable catch in a given fishery. Two RFF researchers, James Sanchirico and Richard Newell, are working with a New Zealand colleague, Suzi Kerr of the Motu Economic and Public Policy Research Trust, to analyze that country's program—considered to be the most comprehensive ITQ system in the world—to see what lessons can be learned.

More than 15 other countries have followed New Zealand's lead and established similar programs covering some 60 fisheries, including 4 in the United States. Even though the current set of programs are getting positive reviews, their political future is unclear. In 1996, Congress established a moratorium against fishing quotas to allow time for the establishment of national standards for determining fishing quotas. That

moratorium expired October 1, 2000, and several congresspeople are holding hearings about how to move forward. Sen. Olympia Snowe, R-Maine, has introduced S. 637, the Individual Fishing Quota Act of 2001, which would amend the Magnuson-Stevens Fishery Conservation and Management Act to authorize the establishment of, and conditions for, individual fishery quota systems.

#### The 'Race to Fish'

The dual problems of overfishing and over-capacity (in terms of number of fishing vessels and equipment capacity) have been studied for decades. Without any sense of ownership over fish until they are caught, fishermen engage in a "race to fish." And the historical record shows that the race will continue until fish stocks are depleted and the number and types of vessels in a fishery

#### New Zealand Fisheries Geographic Zones

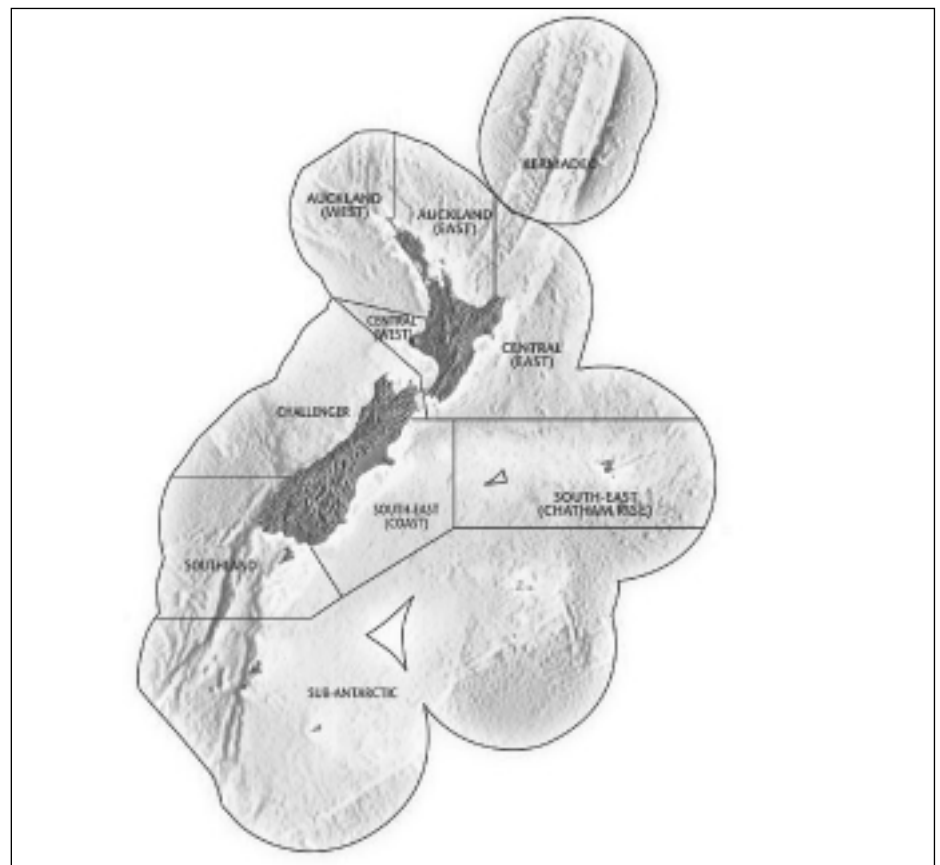


Figure 1: New Zealand's quota management system covers more than 40 fish species distributed across 10 geographic zones. Many individual fish stocks cross over several zones. (©1998 Clement & Associates Ltd.)



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exceed its viable capacity. Because fishermen have a guaranteed share of the TAC under the ITQ model, ITQs eliminate the race to fish. Another benefit is that fishermen have a financial stake in the resource—the quota share is an asset whose value is directly related to the health of the fish stock—and thereby should take into account how fishing today will affect future catch levels.

ITQs essentially give fishermen the right to fish or to transfer, sell, or lease that right. In New Zealand, markets for these rights have been established that closely resemble the successful market in this country for trading sulfur dioxide emissions permits. Sanchirico, Newell, and Kerr are conducting a comprehensive analysis of New Zealand's quota management system, which currently consists of more than 40 fish species ranging across 10 geographic zones resulting in well over 100 quota/lease markets (figure 1 illustrates the 10 geographic zones).

"The idea of a quota system is simple and appealing, but the design and implementation process is mired in politics, which complicates things considerably," Sanchirico said. "We want to develop a rigorous empirical record of how ITQ markets function. Do the big guys force out the little guys? Are there barriers to entering and exiting the market? How well do quota and lease prices correlate to total catch limits, fish prices, and other important variables?"

The researchers believe that their findings will address some key concerns surrounding ITQs. In Congress, legislators will be looking at whether property right regimes should take a more central role in U.S. fishery policy, whether to control the number of shares that an individual can hold, and whether the shares can be traded or leased. ■

### **RFF Researcher Exploring How Chile and Argentina, with Free-Market Economies, Protect Their Water Resources**

By the end of September, RFF researcher Carl Bauer will be settled in Chile, where he will log a year of fieldwork as part of a comparative study of water law and policy in Latin America and the western portion of the United States. This trip, some of which will be spent in Argentina, is an outgrowth of the 10 years of research Bauer has already conducted on Chile.

The idea is to compare Chile and Argentina. Both have carried out, to different degrees, economic and political reforms favoring privatization and free markets in water and electric sectors, says Bauer. In the water sector, he will explore the relationship between these market reforms and the other social, political, and environmental factors that comprise integrated water resource management. Because Chile and Argentina are frequently held up as examples of free-market approaches on the international stage, particularly by the World Bank, Bauer believes that trends in those countries will speak to the development of similar policies elsewhere.

"A lot of the pending water problems in Chile, which is the world's leading example of free-market water policies, have to do with those kinds of issues that are not well handled by markets, such as ecological preservation and coordination of different kinds of water users in a shared river basin," Bauer says. Consequently, there is a need for research on the legal and institutional frameworks that should be associated with markets.

In the electric sector, both Chile and Argentina are notable for their market-oriented policies and deregulation and, like

the rest of South America, they depend heavily on hydroelectric power. "The question in both Chile and Argentina, as well as in the western United States," Bauer says, "is what is the impact on water and dam management of electricity deregulation?" Argentina's electric system is closely linked to the systems of neighboring countries, much like the relationship between California and its neighbors. Bauer hopes his findings in Argentina will shed light on the complex links between water and energy problems in California and other western states.

Bauer also is interested in the changing role of the South American courts. As markets are strengthened, government regulation has been weakened and reduced, which means courts in Chile and Argentina must take on a larger and more difficult role in resolving policy conflicts and regulatory issues. The challenges facing the courts dovetail with another ongoing interest of Bauer's: the relationship between law and economics in professional and academic circles.

"I try to bring law and economics down to earth in the area of property rights because, in my view, that is where law and environment and economy come together," explains Bauer. "I hope to come out of all this with a better understanding of the interdisciplinary nature of property rights and institutions, and the relative contributions of legal and economic perspectives to understanding these issues."

Funding for this project is provided by the Hewlett Foundation's U.S.–Latin America Program and RFF general support. ■



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### Working with Local Officials, RFF Researchers Designing System to Control Air Pollution in the 'Pittsburgh' of China

Following a visit earlier this spring to Shanxi Province, in north-central China, to confer with government officials, a team of RFF researchers has started designing a system for controlling air pollution in Taiyuan, the provincial capital. This area is the industrial heartland of China and has been likened to the Pittsburgh of 75 years ago, with virulent air pollution and public health concerns to match, including high pulmonary and respiratory disease rates and decreased life expectancy.

RFF received a technical assistance contract from the Asia Development Bank to enhance the use of market-based instruments to improve air-quality management in the province and to strengthen the institutional capabilities of the provincial agencies involved in environmental matters.

The RFF team is composed of senior fellows Richard Morgenstern and Alan Krupnick, visiting scholar Ruth Greenspan Bell, and research assistant Xuehua Zhang. They recently met with representatives from the provincial and city planning commissions and environmental protection bureaus and toured local factories to gain a thorough perspective on current practices and to better understand the scope of the environmental and public health problems at hand. They are now working on a plan of action for a demonstration project in Taiyuan that would establish a sulfur dioxide ( $\text{SO}_2$ ) emissions trading program modeled in part after the successful  $\text{SO}_2$  trading program in the United States.

To carry out the demonstration proj-

ect, the RFF team will work closely with local officials to define precise environmental goals, establish the administrative framework of the program, analyze potential cost savings from trading and the likely allowance prices, develop implementation guidance, assess monitoring needs, and work on training and capacity building. The project is expected to take approximately 15 months.

According to Morgenstern, there is broad political support at high levels of the People's Republic of China government for improving air quality and integrating market mechanisms into the country's still-evolving legal and enforce-

ment framework. "It's the most exciting project I've ever been involved with," he said. "We have an opportunity here to use innovative methods to reduce emissions in the world's most populous country."

The potential for achieving dramatic health benefits is enormous, Morgenstern said, including a significant reduction in premature mortality. However, achieving those health benefits poses daunting challenges, he said. Taiyuan is considered by the World Bank to be the dirtiest city in the world in terms of air pollution. ■



*Steelworkers at a coking facility in Taiyuan*



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### At Recent RFF Conference, Scientists from Array of Disciplines Debated the Economics of Resistance to Antibiotics

Resistance by pests and bacteria to all efforts to control them is a common problem. Pest resistance to transgenic or genetically modified crops and viral resistance to HIV medication, for example, threaten to undo some of the most remarkable scientific achievements of the past century. RFF recently held a conference to explore issues relating to the evolution of resistance and how it is affected by the economic behavior of individuals and institutions.

According to RFF Fellow Ramanan Laxminarayan, who organized the conference, the understanding gained through environmental and natural resource economic models can be applied to the problems of treating infectious diseases in general and antibiotic resistance in particular. Both of these problems are characterized by externalities. On the one hand, individuals fail to take into consideration the impact of receiving successful antibiotic treatment on lowering their likelihood of passing on the infection to other individuals. On the other, individuals ignore the cost of increased resistance—and therefore depleted usefulness—to the rest of society when they choose to use antibiotics.

The conference specifically focused on the economics of drug resistance and the economics of pest resistance in agriculture, in separate workshops. The audience of nearly 70 participants included economists, medical and plant epidemiologists, ecologists, agronomists, physicians, and policy-makers from academia, industry, and government, in both the United States and Europe.

#### The Economics of Drug Resistance

In the first session, Jim Wilen, University

of California at Davis, and Gardner Brown, University of Washington, Seattle, gave presentations on the optimal use of antibiotics in a hospital setting. Both researchers used epidemiological models of the evolution of infection and resistance to characterize the order and manner in which antibiotics should be used to maximize their benefit to society while minimizing the individual and social costs of bacterial infection. In their models, resistant bacteria were assumed to bear an evolutionary disadvantage compared to susceptible bacteria when no antibiotics were being used. This disadvantage, also called the fitness cost of resistance, could potentially enable antibiotics to be used as renewable resources since antibiotics can be periodically be removed from active use and allowed to recover their effectiveness.

The second session dealt with the contradictions between the current system for prescription treatment guidelines for patients and the need to address the problem of rising drug resistance. Martin Weitzman, Harvard University, showed that uniform treatment guidelines are inherently problematic in the case of treating infectious diseases, because they place excessive selection pressure on resistant bacteria to evolve. He further demonstrated that standard cost-effectiveness analyses that failed to take into account the social cost of resistance could be fundamentally flawed and concluded that treatment heterogeneity using a variety of drugs could constitute a more prudent strategy to follow, even if some of the drugs were not cost-effective from the individual patient's perspective.

Marc Lipsitch, Harvard University, opened the third session with a presentation of his work on epidemiological models

and issues pertaining to measuring and interpreting associations between antibiotic use and penicillin resistance in *Streptococcus pneumoniae*. David Howard, Emory University, presented a framework for assessing the social costs of resistance, specifically a model in which physicians selected antibiotics both on the basis of their attributes as well as their effectiveness against infections that are resistant to older drugs. Based on this model and a large individual-level dataset on the treatment of ear infections in the United States, he estimated that resistance increases antibiotic spending on ear infections by \$82 million annually.

The final session of the workshop featured an open discussion of the key elements of epidemiological models that are critical to any economic analysis of the resistance problem. Thus far, economists have focused on the role played by natural selection in the evolution of resistance. However, in the case of resistance to antibiotics, natural selection is not the only mechanism by which resistance evolves. Bacteria possess the ability to directly transfer genetic material between each other using a mechanism known as plasmid transfer. Plasmids are packets of genetic material that serve as a vehicle for the transfer of resistance between different bacterial species and are believed to be responsible for the geographical spread of resistance among regions of the world.

The natural scientists spoke of the importance of incorporating dynamics of plasmid transfer of resistance and fitness cost of resistance into future economic models of resistance. Further, they underscored the importance of linking specific model assumptions with the observed realities of a particular disease, such as tuberculosis or gonorrhea, so that the policy implications of such economic models



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for the treatment of a particular disease could be understood better.

### The Economics of Pest Resistance in Agriculture

The second workshop was devoted to the economic consequences of pest resistance to pesticides and genetically modified crops that have been engineered to be pest resistant. In separate presentations, Felicia Wu, Carnegie Mellon University, and Justus Wessler, Wageningen University, discussed their research on the use of the real option value approach—measuring the value of taking a course of action immediately versus at a later date, when more information will be available—to estimate the costs and benefits of irreversible changes in pest resistance that would be brought about by the introduction of genetically modified crops.

Timo Goeschl, University of Cambridge, outlined a fundamental incompatibility between the dynamics of the patent system and the resistance problem as it applies to pesticide effectiveness.

He showed that the patent system—which encourages manufacturers to come up with new products—is incapable of sustaining society against a background of increasing resistance problems. In addition, he said, the externalities within a patent-based system indicated that decentralized mechanisms could result in systematic underinvestment in new pesticides. Hermann Waibel, Hannover University, provided an overview of the economics of pesticides and how the insights gained from the relatively long history of pesticides could be used to assess the impact of pest-resistant transgenic crops.

There were common and contrasting themes between the two days of the conference. For example, the fitness cost of resistance—which allows both antibiotic effectiveness and pesticide effectiveness to be treated as renewable resources—was a common element in many discussions. Further, empirical analyses were presented on both days that attempted to quantify the cost imposed on society of evolving resist-

ance to antibiotics in medicine and pesticides in agriculture.

The contrasting incentives for pesticide manufacturers and drug firms to take into consideration the societal cost of resistance to their products was also discussed in detail. The consensus view among the participants was that the incentives for developing new antibiotics encourage the development of broad-spectrum drugs that are active in promoting bacterial resistance since they impose broad selection pressure on all bacteria in a patient's body, including ones that are not causing the infection. However, in the case of pesticides, regulations written with the environmental side effects of pesticides in mind have resulted in the development of relatively narrow spectrum pesticides that do not place broad selection pressure on all pests.

The papers presented at the conference will appear in *Economics of Resistance*, to be published by the RFF Press early next year. Audio transcripts of the conference proceedings can be found on the conference webpage at [www.rff.org/resistance](http://www.rff.org/resistance). ■

### RFF Receives Major Grant to Support New Fellowships to Study Implementation of Environmental Regulations

RFF has received a \$1.2 million grant from the **Andrew W. Mellon Foundation** to support fellowships for scholarly research that documents how environmental regulations have been implemented and their actual outcomes. The objective of the fellowships is to develop a base of scholarship that systematically examines environmental regulations in practice, and that subsequently will be used to inform regulators, industry, and others on assumptions of environmental laws and

policies. Beginning in 2002, RFF will award two-year fellowships to academicians and scholars from the country's leading universities and research organizations. Information on how to apply for the fellowships will be published in the fall issue of *Resources*.

In addition, the **Smith Richardson Foundation** awarded RFF a \$200,000 grant to conduct a performance-based analysis of the effectiveness and efficiency of environmental regulations. The

research will draw on a dozen in-depth case studies of major environmental programs in the United States and Europe to illuminate the actual performance of different policy instruments addressing similar environmental problems. Senior Fellows **Winston Harrington** and **Richard Morgenstern** will lead an international team of researchers who will use retrospective analyses to compare the performance of two different types of environmental regulations—command-and-control versus economic incentives.