RFF

Resources

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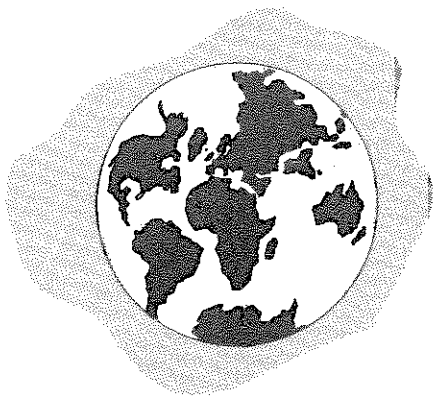
Contents



U.S. foreign policy and global natural resources

IN THE NEWLY PUBLISHED RFF BOOK, *U.S. Interests and Global Natural Resources*, my coauthors deal in some detail with U.S. national interests concerning energy, minerals, and food. In their examinations, they necessarily raise questions of foreign policy inasmuch as they are inherent in the problems at hand. Indeed, one of the major themes of the volume is that U.S. resources cannot be considered as purely domestic. The markets in which they are traded are global and, at least since the turbulent 1970s, foreign policy issues are inseparable from the demand and supply of the major natural resources.

Still, the other analyses are primarily resource-based. My task is to turn the issue around and to look at it, not from the resource side of the intersection of the two sets of policies, but from the foreign policy side. In so doing I address three broad questions: What roles have global natural resources—in particular energy, nonfuel minerals, and food—played in the making of U.S. foreign policy? Are their roles likely to change in the near future? Should they? For the purposes of this article, I limit my discussion mostly to food.

Foreign policy history

Let us begin with a capsule historical tour, and remind ourselves that before World War I the United States had little in the way of an active foreign policy in general, and no economic foreign policy as such. The nation and its government were passive and took the world as given. Americans accepted British financial and commercial dominance as more or less immutable fact. During the period up to World War I, the United States was a capital importer, both in the narrow sense of being a net capital importer on the balance-of-payments account, and in the broader sense of being an even larger capital importer through immigration.

Even in situations in which U.S. actions had large impacts on the international economy—for example, when the country became the major international wheat exporter, displacing other suppliers—Americans hardly were conscious of the changes and their international impacts, and certainly took no policy actions concerning them.

For much of the time between the two world wars, U.S. foreign economic policy (and foreign policy in general) was dominated by international financial and related trade issues that were consequences of World War I. The nation shifted from a debtor to a creditor position, and questions

arising from postwar debts and reparation formed the central focus of foreign policy.

Then came the 1929 Crash and its consequences. The U.S. dollar was devalued, both financial and commercial policy were dominated totally by domestic considerations, and U.S. international economic policies intensified the problems of the world economy rather than helping to resolve them.

The interwar period saw the beginning of the growth of U.S. business interests abroad. They were then primarily investments in the extraction of natural resources: oil in the Caribbean and Venezuela, and a little later in the Middle East; and minerals in the other Latin American countries, and to a small extent in Africa. In the late 1920s and early 1930s the concept of strategic materials became implanted in the national consciousness and, just prior to World War II, thinking about strategic materials played an important role in the U.S. attitude toward Japan. Americans saw Japanese expansion into Southeast Asia as a threat to supplies of natural rubber, on which the United States then was nearly totally dependent, as well as to tin supplies. These perceived threats certainly had an impact on the timing of the war's outbreak, although the ultimate choice was Japan's.

During the war, interest in strategic materials took on substantial importance, principally through U.S. and Allied strategic bombing campaigns and programs of preclusive purchases of ferroalloys in neutral countries aimed at restricting German access. The bombing campaigns were moderately successful, at least with respect to oil, although their success came from the damage Allied air forces inflicted on refining capacity and synthetic oil plants, rather than from a direct impact on raw material supplies. The preclusive purchasing effort resulted in profits to Spanish and Turkish suppliers, and even a fall in Spanish agricultural supplies, as farmers left their farms to comb the hills for ferroalloy ores that the United States was buying at ridiculously high prices. It is not recorded that these purchases had any discernible impact on the German war effort.

After the war, the idea that some materials were strategic because of their potential significance for military production continued to concern policymakers. It certainly played a role in the origins of President Truman's Materials Policy Commission, known after its chairman, William S. Paley, as the Paley Commission. Of course, the perspective of the commission was far broader than supplies for military purposes. Rather, it framed its inquiries in terms of economic growth, and the relation of the future availability, accessibility, and price of materials to the possibilities for continuing long-term economic growth.

Wartime experiences with raw material supply problems—both the direct consequences of the early Japanese advances in the Pacific and the ideas that lay behind the efforts to restrict German supplies—played a central role in the postwar U.S. decision to initiate and maintain stockpiles of strategic materials. But while the reasons for initiating the program stemmed from these experiences, the management of the stockpile as time went on responded increasingly to other pressures. Some of these arose from the concerns of U.S. domestic producers, and others from the anticipated impacts of stockpile transactions on allies and friendly nations abroad.

The Soviet Union and security

No matter how one reckons it, the immediate postwar period ended in 1947 at the latest. From that time on, U.S. foreign policy has been dominated by security concerns, whether the time marker is taken as the Berlin blockade or as the preceding breakdown of U.S.–Soviet discussions about the German economy, when it was clear that the Soviets were interested in occupying East Germany and not in discussing the German economy as a whole.

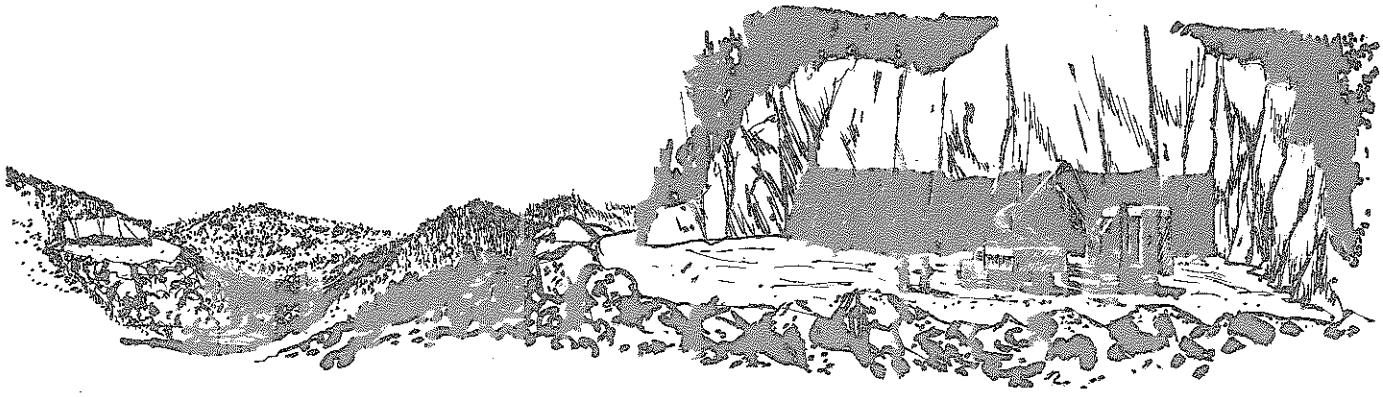
Americans first thought of their differences with the Soviet Union in global terms—as a struggle against communism. A little later, the struggle was with the Sino–Soviet bloc. Of course, the bloc never was as monolithic as it was perceived to be, and sometime in the mid-1960s America discovered that it had dissolved. For the past twenty years or so, the United States has focused more directly on the Soviet Union and less on world communism, though the Reagan administration has revived anticommunism as a major theme. Whatever their guise, these struggles and the security concerns they give rise to have been the central and dominant features of U.S. foreign policy. They have overshadowed almost all other foreign policy considerations, and they have been the touchstone of most—though not all—foreign policy decisions.

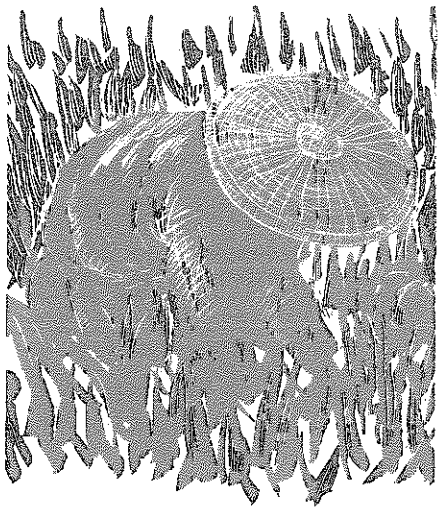
As the leader of an alliance locked in more or less worldwide struggle, the United States maintained a continuous strand of foreign economic policy that had as its highest priority the return to and then the maintenance of a liberal international economic order. An international economy was sought in which trade and worldwide movement of capital were as free as possible, and in which firms received national treatment in other countries.

The remarkable continuity of this broad policy over the nearly forty years since the end of the war has had two foundations. The first was the security commitment. Successive U.S. administrations believed that the way to promote the strength of what was called the Free World was to argue for, and pay for, a liberal economic policy. And America did bear the costs of leadership. The second and related foundation reflected U.S. economic interests. The United States maintained the monetary standard, as Britain had in the century before. And U.S. foreign investments were growing, first in mineral and energy production, and later in manufacturing. Though still concentrated in Canada and Latin America, they spread to Europe and then to the rest of the world. Thus, U.S. security and ideological commitments paralleled the economic interests of American business nationals.

Foreign policy and food resources

Food has played a continuous, if clearly secondary, role in U.S. foreign policy. With





few exceptions, domestic interests and concerns have dominated international considerations in shaping U.S. food policy. The major themes of policy have been restricting imports and promoting exports, both obviously reflecting the interests of domestic producers and their continuing political strength. But U.S. agriculture increasingly is influenced by foreign markets and international events.

Exports and imports. U.S. farmers are highly efficient producers of the major food export crops—grains and soybeans. In the past decade and a half, U.S. exports of agricultural products have grown nearly seven times, and the net balance of U.S. agricultural trade more than twelve times. In a period of trade deficit, the contribution of agricultural exports to the trade balance has grown steadily, at least until 1981–82. This explains the obvious U.S. interest in a continuing commercial diplomacy directed at removing further barriers to imports of U.S. food products, especially in Western Europe and Japan.

On the import side, the United States itself has maintained a variety of barriers, the most important of which have concerned dairy products, meat, and sugar. The barriers to imports of dairy products and meat are in the form of health regulations, and thus ostensibly not a matter of foreign policy. But many barriers imposed on imports from the United States by other countries also appear in forms other than tariffs and import quotas, and U.S. officials hardly are ready to accept them at face value as reflecting only health or safety concerns and the like.

The sugar situation is more straightforward. For a long time the United States has subsidized domestic beet sugar production heavily, and restricted by quota imports of the cheaper cane sugar from semitropical producers. The allocation of the import quota among producers has been used regularly as an instrument of foreign policy, to reward friends, such as the Dominican Republic, and punish enemies, such as Castro's Cuba.

Surplus management. For a long period after World War II the major instrument of domestic agricultural policy was price support of the chief cereal crops, cotton, and tobacco, maintained by government purchase of (or loans against) that part of the crop that could not be sold at or above the support price. The result was an accumulation of grain and, to a lesser degree, raw cotton and tobacco in government stocks. This in turn led to a policy of using surplus crops as a large part of U.S. economic aid to developing countries, first under Public Law 480, and then under the slogan, "Food for Peace."

The domestic purpose of these programs has been clear, and they have enjoyed broad political support. But their consequences for the recipients have been a matter of some controversy. It generally is agreed that untied aid equivalent to the world market value of the food would have been more helpful to the food-short countries. Many further believe that food aid has acted as a disincentive to local agriculture in recipient countries, reinforced governments in policies that were inimical to agriculture, and thus delayed progress toward food self-sufficiency that they otherwise could have achieved.

U.S.–Soviet relations. The exceptions to the broad dominance of domestic agricultural interests in shaping food policy have centered on U.S. relations with the Soviet Union. In 1966–67—an early marker of the beginning of détente—the United States negotiated its first grain sale with the Soviets. The full blooming of détente led to the signing, in 1975, of the first five-year U.S.–Soviet agreement on grain sales. That agreement, of course, fell victim to the Soviet invasion of Afghanistan in 1979 and President Carter's decision to restrict, but not eliminate, grain exports to the USSR as a sanction. Two years later, in April 1981, President Reagan lifted the Carter partial embargo, belatedly fulfilling a campaign promise, despite the continuing occupation of Afghanistan and the fact that U.S.–Soviet relations in general had worsened. Lifting the embargo, however, was as far as the Reagan administration then wished to go: the United States offered no new long-term agreement, and Soviet short-term grain purchases from the United States were significantly lower than they had been before the partial embargo.

In December 1981 the Polish government's declaration of martial law in its effort to suppress the Solidarity trade union led to the suspension of U.S. government credit for Polish grain purchases, and the further American refusal to negotiate a

(Continued on page 12.)

Ahearne named vice president

ACTING ON President Emery N. Castle's recommendation, the RFF Board of Directors has appointed John F. Ahearne vice president of Resources for the Future. He will assume the post in January, after he completes a consulting assignment in the Office of the U.S. Comptroller General.

Ahearne completed in June a five-year term as a commissioner of the Nuclear Regulatory Commission. He was NRC chairman in the period following the Three Mile Island incident.

The new vice president's NRC appointment capped some twenty years of public service, including several senior positions in the U.S. Departments of Defense and Energy. During the Carter administration he served as deputy assistant secretary of energy for power applications and as assistant to Secretary of Energy James Schlesinger.

Until 1977, Ahearne's work was concentrated in the office of the Assistant Secretary of Defense for Systems Analysis and included appointments as deputy assistant secretary of defense for general purpose programs and as principal deputy assistant secretary of defense for manpower and reserve affairs. Early in his career he taught physics at the U.S. Air Force Academy.

Ahearne received his bachelor's and master's degrees from Cornell University and earned the Ph.D. in physics at Princeton University.

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Global deforestation

The past three years have seen the publication of two major works on the loss of tropical forests and its potential effects—Norman Myers's Conversion of Moist Tropical Forests; *and* Tropical Forest Resources, *a study of seventy-six tropical countries conducted by the Food and Agricultural Organization and the Environment Programme of the United Nations. Both of these have generated great interest in deforestation and have raised a number of important questions. This seems to be an appropriate time to examine some of the problems associated with the loss of tropical forests. For example, is all deforestation undesirable? What types of problems might it create? Are they global or local in nature? Which of the potential impacts will actually be realized?*

On May 2, 1983, Resources for the Future, the Lincoln Institute of Land Policy, the World Environment and Resources Council, and the International Institute for Environment and Development sponsored a conference to discuss some of these questions. Speakers were Norman Myers, author of the 1980 report on tropical forests and an environmental and development consultant; Julian Simon, visiting fellow at the Heritage Foundation, on the faculty of the Universities of Illinois and Maryland, and author of The Ultimate Resource; *Peter Raven, director of the Missouri Botanical Garden, president of the American Institute of Biological Sciences, and the author of several works on tropical biology; and Roger Sedjo, director of the Forest Economics and Policy Program at Resources for the Future. The moderator was Robert Goodland, environmental affairs officer at the World Bank. Pierre Laconte, president of the World Environment and Resources Council, was the commentator.*

The article that follows has been prepared from the speeches and the discussion.

Effects of deforestation

ROGER SEDJO: There appear to be four separate and identifiable types of potential problems arising from deforestation. First is the question of industrial wood supplies; second, the availability of fuelwood; third, environmental impacts; and fourth, the loss of unique plant and animal species. Each of these can, in principle, be either local or global in scope, or perhaps both.

Since industrial wood and wood-using products are heavily traded internationally, availability of supplies is a global problem. A particular country need not be self-sufficient in wood, but there should be areas of surplus or deficit and some international trade, balancing out the needs and production of a region. For a number of reasons, future supplies of industrial wood do not seem to be in jeopardy.

By contrast, the fuelwood issue is almost entirely local or regional and, as such, is in principle amenable to solutions at the local level. It is clear that fuelwood scarcity is a serious problem in some regions of the world.

Environmental problems can be either local or global. Clearly, numerous serious local environmental problems are caused by deforestation—both in the tropics and elsewhere. However, there is little evidence of serious global environmental damage related to current rates of deforestation. The 1982 *Carbon Dioxide Review* states flatly, "No one any longer suggests land-use changes will produce a significant fraction of man's total future releases of CO_2. If there is a carbon dioxide problem in the future, it will be due to the burning of fossil fuels, not the burning of forests."[1]

Finally, there is the question of losing genetic resources. Enough evidence exists to suggest that this is certainly a potential, and probably an actual, problem. However, it is difficult to assess the extent and seriousness of the problem. Estimates of future losses of species are, at best, the crudest of guesses and are made more difficult by lack of reliable information on past losses. Thus, projections of losses over the next twenty years are, at best, very tenuous. Nevertheless, there are reasons to believe that genetic resources concentrated in tropical forests may experience excessive rates of destruction. It also is clear that habitats housing unique genetic

[1]William C. Clark, ed., *Carbon Dioxide Review*. Prepared for the U.S. Department of Energy by the Institute for Energy Analysis–Oak Ridge Associated Universities (New York, Oxford University Press, 1982) p. 4.

resources are threatened, particularly in coastal Brazil and Madagascar.

Most of the problems of excessive deforestation are related to the common property nature of that resource. A resource that belongs to everyone ultimately belongs to no one and is exploited not only beyond its biological sustainability, but also beyond its economically optimal level. Hence, neither ecological nor economic criteria are satisfied. Enlightened policy, therefore, must recognize this reality and design institutions that will address this problem.

There has been a tendency to seriously overestimate the extent of global and tropical deforestation. Nevertheless, for some regions and in some locations, the rate of deforestation is excessive by both ecological and economic criteria.

Second, there are serious existing fuelwood and environmental problems in many locations. These require remedies that recognize the common property nature of these resources and may involve important local institutional changes.

Third, there are serious potential problems related to the protection and preservation of the world's genetic resource base; again, institutional changes are required to afford these resources adequate protection.

Safeguarding tropical forests

NORMAN MYERS: My fundamental finding is that tropical moist forests are undergoing outright elimination at the rate of 9.1 million hectares a year, and they are also undergoing gross disruption and biological impoverishment at a rate of 10 million hectares a year or a little more.

Tropical forests cover less than 7 percent of the earth's surface, and yet they contain almost half of all species on earth. Nowhere else is there this extraordinary concentration of life forms, many of which could benefit mankind. Yet so far less than 1 percent of all those species has been examined. If the arthropods are included, the figure is more like 1/100th of a percent.

I think a case can be made for saying that the species found in tropical forests represent one of the most valuable and unique stocks of natural resources. The paradox is that despite the many goods and services they offer, tropical forests rank among the least developed of all natural resource stocks on earth—developed in the sense that they provide material products and environmental services on a sustainable basis and serve long-term human needs.

On the other hand, they are being exploited for timber, for cattle ranches, for food for a few people. Hardly any of this exploitation is planned and managed.

The key question is not how to safeguard all the tropical forests; the questions we must ask are much more complex and much more relevant: Which sectors of tropical forests should be utilized and how should they be utilized? What sort of needs should they meet and over what period of time? Finally, what are the costs of a particular use compared with others?

I would like to suggest that development of tropical forests can include "wise use" for less established, though equally valid purposes, to go along with more traditional uses. If the emphasis is on sustainable, overall outputs of tropical forests, such services can be seen as a form of development that ranks alongside timber harvesting. A national park is just as legitimate a use as a paper pulp plantation. Genetic reservoirs are as important as forestland agriculture, and in certain localities use can entail outright preservation of forest ecosystems for scientific research. Wise, planned use would not only benefit mankind, but would leave a lot of tropical forests standing at the end of this century and, more important, at the end of the next one.

Species preservation

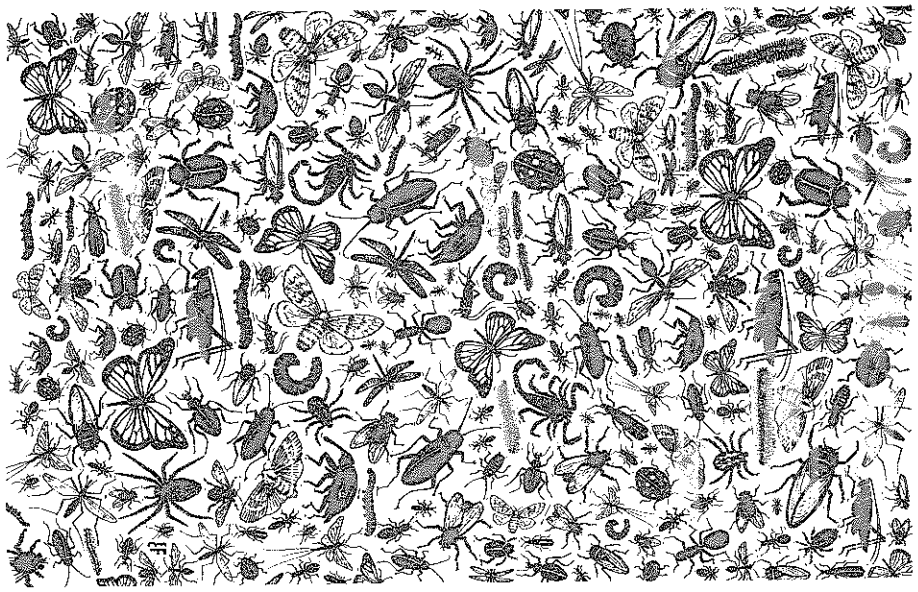
JULIAN SIMON: Based on a memo by Thomas Lovejoy, the *Global 2000 Report* said in its "Major Findings and Conclusions" section: "Extinctions of plant and animal species will increase dramatically. Hundreds of thousands of species—perhaps as many as 20 percent of all species on earth—will be irretrievably lost as their habitats vanish, especially in tropical forests." I submit that this prediction is based on virtually no evidence.

The proximate source of the assertion is a book by Norman Myers, *The Sinking Ark,* from which these key points may be extracted.

1. The estimated extinction rate of known species between the years 1600 and 1900 was about one every four years.
2. The estimated rate from 1900 to the present was about one a year.
3. Some scientists (in Myers's words) have "hazarded a guess" that the extinction rate "could now have reached" 100 species per year. In other words, that estimate is simply conjecture and is not even a point estimate but rather an upper bound.
4. Even the guessed upper limit in (3) is then increased and used by Myers, and then by Lovejoy, as the basis for the "projections" quoted above, which calculate to about 40,000 species lost per year.

That is, an upper limit for the present which is pure guesswork, and which is a hundred times the observed rate in the recent past, has become the basis of a forecast for the future which is 40,000 times greater than at present and has been published in newspapers to be read by tens or hundreds of millions of people and understood as a scientific statement. Looking at the two historical points alone it is clear that, without explicitly bringing into consideration some additional force, one could extrapolate almost any rate one chooses for the year 2000, and the Lovejoy extrapolation has no better claim to belief than a rate, say, 1/100th or 1/40,000th as large.

This reanalysis does not imply that species are in no danger. As I see it, it implies that much more careful analysis, including cost–benefit analysis of the resources devoted to saving species versus other uses of value to mankind, is necessary before there is reasonable basis for policy recommendation. Can you now share my view that the available evidence does not support the frightening conclusions that are drawn from it?



I do not intend to suggest that our society and humanity at large should not worry about possible dangers to species. But we should strive for as clear and unbiased a view of this set of assets as possible in order to make the best possible judgments about how much time and money to spend in guarding them in a world in which this worthwhile activity must compete for funds with other worthwhile activities.

A delicate balance

PETER RAVEN: The World Bank estimates that 600 to 800 million, or one out of every three people in the tropics, is living in absolute poverty. By the end of the century, about 60 percent of the earth's people will be living in the tropics, owing to an unequal distribution of population growth. Clearly, these people will have no recourse in most cases but to turn to the tropical forest for their sustenance, increasing the rate of deforestation and destroying the plant and animal populations of those forests.

The relationship among organisms in tropical forests is the most intricate and tightly linked example of mutualism and interaction among organisms found in any biological community in the world. Scientists are only beginning to learn a little about the way that energy and minerals flow through tropical ecosystems and are recycled. Because of this delicately balanced exchange of nutrients, about which we know so very little, tropical forests are among the most easily disturbed of any in the world.

There are, in temperate regions, about 1 million known species of organisms and probably 1.5 million unknown. Any group of organisms which is reasonably well known has twice as many species in tropical regions as it does in temperate regions. A conservative estimate is that there are at least 3 million species of organisms in the tropics, about 500,000 of them known.

In coastal Brazil, 95 percent of the state of Bahia has been deforested. Ninety-eight percent of western Equador has been deforested in the past twenty years. Only 7 percent of the vegetation of Madagascar persists in some semblance of natural order. There are about 12,000 species of plants in Madagascar, about 7,000 found nowhere else, and they are confined to those pockets of the remaining 7 percent of vegetation.

Quibbling about extinction rates in the face of what is actually happening in the tropics is tantamount to watching a forest fire raging down a mountainside and saying, "Well, we ought to do something about that forest fire, but first let's find out a little more about the nature of fire."

Very little research is being done anywhere in the world on how to convert tropical forests into productive systems. The tree plantations that exist are in warm, temperate areas and not in the tropics at all or are in southern parts of Brazil.

It is evident in the face of the rapidly growing human population that every inch of the ecosystem will need to be fully used. The problems of doing this must be recognized.

Extinction—Now or later?

THOMAS LOVEJOY, *World Wildlife Fund*: As has been mentioned, there are millions of species in the tropics and there are simply not enough scientists available to work on the problem of the rate of extinction. One has to approach it from a slightly different point of view.

Certainly, the whole exercise should always be a matter of projections rather than a matter of predictions. It is probably difficult and unreal to try to convert the figures into rates. That assumes we know something about the shape of the curve of tropical deforestation out into the future.

My own approach is to look at the problem in terms of the area of deforestation versus the number of species that might be lost with that area. In doing this it is important to realize that secondary tropical forests hold a very tiny fraction—probably less than 5 percent—of all the species found in the great, skyscraperlike primary forests of the tropics. In addition, it is very important to recognize that large deforested areas in the tropics, because of the nature of tropical ecosystems, have very slow recoveries, perhaps infinitely slow in terms of the human experience. If one ignores the *Global 2000* estimates for the moment and merely asks what the shape of the curve should be when the amount of tropical forest area lost and the number of species lost are related, then one begins to get something that is free of time considerations.

One could choose a curve that goes up much more rapidly than a linear relationship, indicating that deforestation is expected in areas containing concentrations of species with limited distributions. Or one could assume that the deforestation will aim away from some of these key areas. That, in fact, was one of two curves that I chose in doing my calculations in the *Global 2000* report. The important thing is that however the estimates are done, and rough as they are, the numbers come out to be fairly large. I used numbers because people think of endangered species as individual things rather than as part of a continuing process of biotic impoverishment.

I would contend that—as important as it is to determine precise rates of tropical deforestation, if only to get a better grip on this problem—in a sense all we are arguing about is the date of extinction.

Carbon dioxide emissions

MARION CLAWSON, *RFF*: I think there is one aspect of deforestation that has been rather regularly overlooked. That is what has happened to the volume of wood harvested and its net contribution to carbon dioxide in the atmosphere.

When forests are cut, they are not invariably immediately retranslated into carbon dioxide. Sometimes, indeed, the wood is burned and the conversion is much quicker than if the wood had rotted slowly. But sometimes, and particularly in the temperate zone forests, the wood is converted into usable forest products and may stay in that form as long as it would have stood in the forest had it not been cut.

I have done some rough calculations that indicate there is half as much wood fiber outside of the forests in the United States today as there is standing in the forests. I think that in the past two generations, U.S. forests have added substantially to the amount of carbon dioxide embodied in wood rather than in the atmosphere.

I strongly suspect that if one constructed the best possible model of what has happened over the past generation, the past century, one would find that forests, instead of contributing to the carbon dioxide of the atmosphere, globally have removed at least as much carbon dioxide as they have contributed.

This is a line of inquiry that is worth pursuing—that is, the volume of wood involved, not merely the acreage.

Commercial versus noncommercial losses

EMERY CASTLE, *RFF*: I think there is agreement that species have value and that when species are lost, we have lost something of value. I believe everyone also agrees that when we make commercial uses of tropical forests, we sometimes sacrifice noncommercial uses, of which species loss is one example. If that is so, then it seems to me that there needs to be discussion about how one measures or compares commercial loss—or commercial use as contrasted with the noncommercial loss.

Are we suggesting that all commercial uses be eliminated? I think not. But if not, what commercial uses are going to be permitted and how are they going to be related to the noncommercial losses that everyone is concerned about? It has been

suggested that the possible basis of the problem is a property right issue, that in some cases there is open access to these resources—resources of real value to humankind—and yet there is no real discipline governing the ways in which they are used.

Regeneration

ELLIOTT NORSE, *Ecological Society of America*: What has not been discussed is the rate of regeneration of forests. If, as Tom Lovejoy has pointed out, secondary forest has 5 percent of the species of primary tropical forests, then it is important to know what the rates of regeneration are. No matter what the acreage is, the question still is very germane. How fast are the primary forests regenerating? Will they regenerate quickly enough so that losses in one place are compensated for in another? If not, we are losing forests as the world's population increases. Something will have to give somewhere.

Another point that has not been brought up is the rate of evolution versus the rate of extinction. Some species evolve rapidly, but for many others it takes tens of thousands to hundreds of thousands of years to evolve. On the other hand, it takes only a very short time to wipe some species off the face of the earth. The inevitable consequence, it seems to me, of increasing activity, increasing extinction, and evolutionary rates that probably are not increasing at all or are being slowed, is that species will be lost.

More important than this is that the confidence we have in various kinds of data varies. For example, different projections of human population growth come within a few hundred million folk by the year 2000 or the year 2050. On the other hand, for how many species of insects do we know the intrinsic rate of natural increase? The answer is a very, very, very small fraction. That figure is just as important to the question of species loss as is the human population growth rate.

Tropical forests and economic development

MICHAEL ARNOLD, *United Nations Food and Agriculture Organization*: I have heard very little that recognizes that tropical forests, as a major natural resource which is mobilized and turned into capital, can contribute to the economic development of tropical countries.

Unfortunately, the exploitation of the tropical forests is not resulting in capital accumulation, largely because most of the forests are being destroyed and not used. This is happening also because the part that is being used is exploited; the value of forest products is accruing, not in the tropical countries, but largely in the industrialized countries to which they are exported.

Then there is the fact that tropical forests are one of the largest remaining land banks, containing probably considerable areas of land which could or might be put to better use under agriculture. Unfortunately, much of the land that is being cleared to produce food is not capable of sustaining agriculture, at least with the techniques available to the poor farmers who are practicing agriculture. The result is the destruction of the land resource.

Surely this is a major reason for describing tropical deforestation as "catastrophic." It is not only destroying the immediate land of the tropical forests, but through erosion, flooding, and silting, is destroying or damaging or degrading huge areas outside the forests that have been previously put under agriculture.

Future considerations

PIERRE LACONTE: There are a few conclusions that can be drawn here. First, there is an urgent need for more research, and there is also a potential for it. It is therefore urgent that additional funds should be allocated.

There is another problem, and that is that satellites constitute an important research tool for studying this problem, but the equipment is expensive and the results of data collection often are not available to the countries faced with deforestation. Some way of transferring this information is needed.

The fact that this conference has agreed on some of the problems and the necessity to know more about them does not bring us nearer to the solution. The solution lies in the heads of the people. You cannot plant trees on the ground before you have planted them in the heads of the people. I think that it is extremely important to explore ways to change attitudes at national and individual levels.

There are in the literature a number of experiments at community levels which have proved very successful, for example, in Korea and in Gujarat in India. I think these opportunities can be explored not only from a scientific but from an institutional viewpoint and that it is urgent to do so.

NORMAN MYERS: We know less about the workings of ecosystems than any other systems on earth. In view of this ignorance, we need to adopt a cautious attitude to our use of tropical forests. As in other circumstances of uncertainty, it would be better to find that we have been vaguely right than certainly wrong. The face of the earth is being changed so very fast that in many circumstances we cannot wait to accumulate sufficient evidence to make a decision.

ROGER SEDJO: The rate at which forests are being denuded is important, for a number of reasons. For one thing, it has direct implications for the rate of irreversible species losses; the slower the rate of deforestation, the more time there is to adjust to it.

We also have to recognize that the world is dynamic. In much of the northern hemisphere, net afforestation is taking place. I will not suggest that that is necessarily going to happen in the developing world and in the tropics, but it is conceivable that there could be adjustments there.

If some forest resources are less accessible, and the rate of deforestation is down, that has implications for species preservation, and is a positive sign. On the other hand, it is clear there are serious problems—population increases apply pressure on the resources. Institutional changes are needed to deal with those kinds of problems and we have to start thinking about institutional structures that will preserve resources.

ROBERT GOODLAND: If a tropical forest is cut, 80 percent or more of the nutrients are gone forever. They are washed out to sea. The forest will not come back; one has only to look at some of the lunar landscapes wherever deforestation has been allowed to proceed to see the truth of this irreversibility.

The ecosystem provides services to many people—protection from floods, attentuation of climate, provision of water in the dry season—and these services are orders of magnitude more important in the tropics than they are in the temperate zones. If tropical forests are cut down, massive erosion may result. That is why many people are made homeless practically every year in Bangladesh and India. I would like to firmly dispel the notion that tropical deforestation is useful. It is not. At most, it gains three harvests for a peasant before he is compelled by declining yields and increasing waste to move on and cut another patch of forest. Even at that level, he can barely survive.

The other gains from cutting tropical forests, I submit, are similarly tenuous and ephemeral. Since biological resources are the most essential natural resource supporting human existence, the cautious approach should prevail. The number of species being lost because of deforestation is almost immaterial. Acceptance of even some extinction can be construed as being one of the ultimate arrogances of our time, for it denies the value of these species to all future generations.

Ruth B. Haas, an editor in RFF's Public Affairs Division, prepared this article from the conference transcript.

Energy discussion papers

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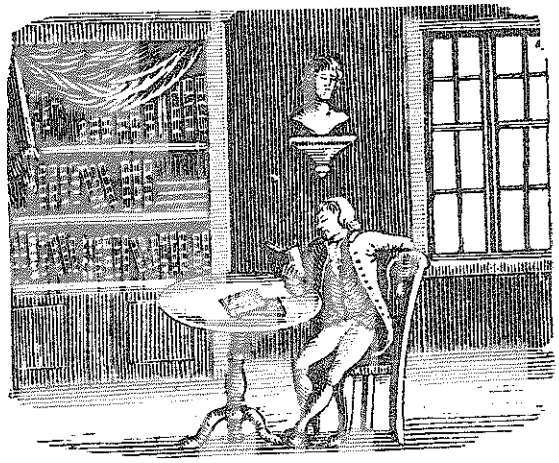

Deregulation of natural gas—Focus on contract carriage

NATURAL GAS HAS BECOME the most pressing energy issue of 1983. Rather than solving the problems of gas markets, deregulation of wellhead prices under the Natural Gas Policy Act of 1978 (NGPA) has introduced a whole new set of concerns. Some stem from the partial nature of deregulation under the NGPA, while others arise from contracting practices and regulation affecting pipelines and distribution companies.

Problems in natural gas markets

Shortages of natural gas were chronic before 1978. Low prices in the field constrained supply and encouraged consumption, and available supplies were rationed by regulatory curtailment mechanisms. Producers, pipelines, and distributors could sell any and all gas they could obtain, and prices were not an issue. Shifts in demand did not affect sales, because under conditions of chronic excess demand such shifts only changed the depth of curtailments.

Rising prices—Falling demand

The NGPA has allowed wellhead price ceilings to rise sufficiently to eliminate excess demand. As a result, factors affecting demand also affect gas sales, and thus all segments of the industry—and final consumers—face new forms of uncertainty.

Regulatory and contracting practices in the gas industry developed during the era of shortage, and some are ill suited to the new era of uncertainty. This mismatch of old institutions and new conditions currently has created three major problems. First, combined with the progress of deregulation of wellhead prices, the old institutions have caused prices charged final consumers of gas to rise above market-clearing levels.

During 1982, deregulation allowed wellhead prices to rise, while a combination of external events depressed the underlying demand for gas. Critical in raising wellhead prices were indefinite escalators in existing contracts between producers and pipelines. In a number of contracts, these escalators set prices equal to the highest price allowed by the Federal Energy Regulatory Commission, so that when price ceilings rose above market-clearing levels the stage was set for a gas surplus. In other cases, pipelines signed contracts for particular categories of gas at prices that could be supported in conditions of the late seventies. But as other gas costs rose in the course of deregulation, average costs were driven above levels that the market would accept in conditions of depressed demand. Some of these contracts had buyer protection clauses allowing prices to be reduced, but many did not.

Depressed demand, in turn, arose from three major factors: warm weather during several successive heating seasons, recession and reduction of activity in gas-consuming industries, and reduction in oil prices that made alternative fuels more attractive. These events would reduce gas demand at any price; the progress of deregulation raised prices and reduced demand further.

As a result, in some markets delivered prices of natural gas have risen above market-clearing levels. In the industrial market, equilibrium prices are likely to be established by competition between gas and residual fuel oil for sales to consumers with dual fuel capacity. Although estimates vary, it is clear that a substantial amount of industrial fuel consumption occurs in boilers with the capacity to switch rapidly between gas and residual fuel oil.[1] These consumers will use gas when it is available at a price below the cost of an (Btu) equivalent amount of residual fuel oil, but will switch off gas when the price rises above it.

By the end of 1982, gas cost more than high-sulfur residual fuel oil in the Pacific, Middle Atlantic, and New England regions. In the South Atlantic, West North Central, and probably also in the East North Central regions, prices of the two fuels were approximately equal.[2] Given the dispersion of prices within census regions, it is likely that a considerable number of industrial consumers in the last three regions faced gas prices above the cost of residual fuel oil.

These prices have caused industrial consumers to switch from gas to residual fuel oil. At the same time, recession has reduced industrial activity and fuel consumption overall, while warm weather and conservation have held down space-heating demand. Between 1981 and 1982, industrial gas consumption fell by 1.3 trillion cubic feet (tcf), electric utility consumption fell by 0.4 tcf, and residential consumption rose by 0.2 tcf, so that total gas consumption fell by 1.5 tcf. Comparing December 1982 with December 1981, demand in all categories fell: residential by 70 billion cubic feet (bcf), industrial by 270 bcf, and electric utility by 30 bcf.[3] This loss of load means that, at current prices, the market will not absorb the quantities of gas pipelines and distributors are obligated to buy.

In a freely operating market, such shifts in final demand would cause prices to adjust back to the wellhead in order to keep supply and demand in equilibrium at all points in the system. Distributors facing lower sales would reduce their purchases in the field; competition among producers for remaining sales would reduce price, with the producers with highest short-run marginal costs reducing their output in response. Lower prices, passed through to consumers, would recapture some demand. After a shift in demand because of warm weather, recession, or declining oil prices, equilibrium would be reestablished with lower field prices and lower production.

In the natural gas industry, contracting and regulatory practices interfere with this equilibrating mechanism. Distributors encountering a drop in demand often find themselves obligated to pay pipelines for gas not taken—either through minimum bill provisions of sales contracts or demand charges in regulated tariffs. Pipelines, whether or not their revenues are guaranteed by distributors, face "take-or-pay" and pricing provisions in their contracts with producers that obligate them to take predetermined quantities of gas at prices that may bear no relation to market conditions. As a result, producers have incentives to produce gas in excess of demand.

Pipelines and distributors cannot long continue to take deliveries in excess of their sales. If prices were free to adjust, producers would face a falling wellhead price and choose efficient, lower production rates. Instead, prices are prevented from falling by certain provisions in long-term contracts, and cutbacks are allocated by other rules that do not equate marginal costs of production. In particular, pipelines may allocate cutbacks in order to minimize the financial penalties resulting from take-or-pay provisions of contracts.

Field market inefficiency

The result is the second major problem in current gas markets. Some producers

[1]American Gas Association, "Survey of Industrial Fuel Switching and Alternative Fuel Capability, 1981–82 (Update)," (1982); and Energy Information Administration, *The Natural Gas Market Through 1990* (Washington, D.C., EIA, 1983).

[2]W. David Montgomery and Michele Gottlieb, "Transport Costs and the Spatial Distribution of Natural Gas Prices" (Washington, D.C., Resources for the Future, 1983).

[3]Energy Information Administration, *Monthly Energy Review* (May) 1983.

find themselves unable to sell gas, though they would be willing to accept prices equal to or lower than those received by others who do continue to sell gas. The resulting inefficient production of gas compounds the inefficiencies created by the multiple price ceilings of the NGPA. Risk allocation also is arbitrary. Producers with stringent contracts are insulated from consequences of falling demand; other producers, pipelines, distributors, and consumers absorb the costs.

Combined with the first problem of excessive burner-tip prices and loss of load, the problem of field market inefficiency implies that there are willing sellers (shut-in producers) and willing buyers (industrial customers priced out of the gas market) who do not have access to one another. Likewise, it implies that some pipelines and distributors are likely to face large losses: the financial obligations involved in buying gas now exceed the revenues achievable when gas is sold.

Regional price differentials

Finally, a combination of factors has caused regional differentials in gas prices larger than can be explained by transportation costs. These factors include field price differentials created by NGPA, producer-pipeline contracts, and downstream regulatory and market institutions that allow pipelines to pass costs through to distributors and other customers. Pipelines differ by as much as a factor of two in their costs of purchased gas, which for mid-1982 were estimated to range from $1.34 (Texas Eastern) to $2.90 per thousand cubic feet (mcf).[4] Regional differences in industrial prices, cited above, are exceeded by differentials in residential prices, which are reported for smaller geographic areas. These ranged from approximately $10 per mcf in some communities in Connecticut to under $3 in Kansas.[5] Such regional price disparities also cause gas to be allocated inefficiently, by preventing marginal willingness to pay for gas from being equated across customers, and concentrate loss of industrial load on particular pipelines and regions.

Time for change

The three current problems—disequilibrium in burner-tip markets, inefficient production in the field, and regional disparities in delivered prices—are symptoms of an industry unable to respond to changing market conditions. Since field price deregulation means that natural gas prices and sales will be determined in competition with other fuels, and will be sensitive to external events, these problems can be expected to recur unless fundamental changes are made in operations of the gas industry.

Carrier status

One change that has attracted considerable attention is in the carrier status of natural gas pipelines. Currently most gas moving in interstate commerce is owned by pipelines, who buy in the field and sell to large industrial consumers and electric power plants ("direct mainline sales") or to local distribution companies ("city gate sales"). Thus, they are technically classified as "private carriers"—transportation companies that move their own goods. On occasion, pipelines will transport for a fee gas to which title is held by others, usually producers or consumers. In these cases they operate as "contract carriers," voluntarily making space available to transport gas for others.

Fears that pipelines will attempt to suppress competition by refusing to grant access have led to proposals for a third form of pipeline regulation: "mandatory" contract or common carrier status. A number of variants on this proposal exist, but all envision a system in which a buyer or seller of gas can compel a pipeline to provide transportation services for a regulated fee. The long-run consequences of such a change in carrier status depend critically on the details of regulatory oversight of conditions for access and setting of fees. Such matters have not been studied in any detail. But a threshold question also exists of what benefits would be provided by *any* form of increased access to transportation facilities for parties who wish to deal directly. This question can be answered as follows: increased access offers unambiguous but limited benefits in the short run. It will not aid those locked into their current obligations to deal with one another, although, by increasing the competition that pipelines face, increased access may contribute to building a more responsive gas market in the long run.

There are two distinct groups in the gas market, each of which will be affected very differently by increased access. One group is composed of the producers and consumers who have essentially "dropped out" of the gas market—that is, consumers who have opted to switch to an alternative fuel and producers whose production has been reduced or shut in by a lack of pipeline demand. In some cases, mutually beneficial trade could take place among these parties, if transportation between the shut-in producer and the potential gas consumer could be arranged.

[4]Energy Information Administration, "An Analysis of Post-NEPA Interstate Pipeline Wellhead Purchases" (Washington, D.C., EIA, September 1982).

[5]*Energy Daily,* May 18, 1983.

The second group is composed of those who have no alternative but to remain within the system—producers, pipelines, distributors, and consumers who are bound together by contracts and regulation. These are parties whose distress has elevated natural gas policy to the status of a major national issue, and they will not in the short run be helped substantially by changes in carrier status. The very conditions that cause their problems also lock them into continuing relationships that limit the benefits of greater access to pipeline transportation for gas purchased directly from producers.

Contractual and regulatory constraints

To see why increased access offers limited short-run benefits, it is necessary to explore further the contractual and regulatory constraints that interfere with achievement of market equilibrium. The problem begins with wellhead contracts that face gas pipelines with costs for gas greater than ultimate consumers are willing to absorb. Whether these costs are borne by pipelines, distributors, or consumers depends on the nature of contracts and rate design.

Contracts between pipelines and distributors mirror in many respects those between producers and pipelines, but they also have unique features. City gate contracts typically are long term and, like their wellhead counterparts, their provisions serve to allocate risk among the signers. In this regard, the city gate analogs to the wellhead take-or-pay provisions are "minimum-take" requirements or "minimum-bill" clauses. These provisions stipulate that a distributor agrees to purchase at least a minimum quantity of gas from a pipeline at prices based on the pipeline's costs. Thus, they serve to reduce a pipeline's losses stemming from excess capacity and to enhance its ability to meet its own take-or-pay obligations at the wellhead. At the same time, they assure supplies to distributors which in turn face end-use service obligations. Tariffs set by the Federal Energy Regulatory Commission for city gate sales often contain provisions with similar effects—demand charges that must be paid regardless of actual deliveries and certifications that link distributors to particular pipelines.

Two provisions are unique to city gate contracts—"sole-supplier" clauses, which obligate a distributor to purchase all of its gas from a particular pipeline, and "territorial restriction" clauses, which obligate a distributor to resell gas purchased from a particular pipeline within a specified geographic area. Many city gate contracts contain both of these provisions.

These provisions may make it possible for a pipeline to shift costs downstream to distributors. The distributors' ability to recover costs is determined by the demand elasticity of their customers and the willingness of regulators to tilt rate structures so that industrial prices are kept below the cost of alternative fuels while rates for residential customers (and others with limited fuel-switching possibilities) are increased.

Matching buyers and sellers

Increasing access could serve to match willing buyers and sellers unable to deal under current conditions, but would not solve the problems that wellhead contracts cause pipelines, distributors, and their customers. Some producers, whose contracts with pipelines contain relatively mild take-or-pay requirements and penalties, are shut in (partially or completely) though they willingly would sell gas at less than market-clearing prices. Industrial customers with dual fuel capability, facing higher prices set by pipelines and distributors, cease using gas though they would buy at prices acceptable to shut-in producers and buyers priced out by pipelines by arranging contract carriage transportation for direct sales. These transactions represent an unambiguous gain, but their benefits are limited in scope. If some contribution to pipelines' or distributors' fixed costs (including take-or-pay liabilities) is made by such transactions, they and their remaining customers will benefit. If customers who otherwise would continue buying from distributors opt for direct purchase, distributors could lose sales and their remaining customers could face higher prices.

The Industrial Sales Program initiated by Transco is an example of how contract carriage can be used to match these willing buyers and sellers. Monthly, Transco estimates how much demand would be lost if all customers faced prices based on its normal tariff. It then matches these demands with supplies from producers who otherwise would be unable to sell gas. Transco sets a price low enough to induce customers to continue to buy gas, deducts the cost of transportation, and pays the net price to producers willing to participate in the system.

However, these new arrangements do not provide for stable, long-run relationships between buyers and sellers. Long-run contracts for gas supplies provide security for the large fixed investments required to produce and transport gas, and share risks among their parties.

Distributors may find it difficult to take advantage of greater access to pipeline transportation of directly purchased gas. If minimum-bill and sole-supplier provisions are enforced, distributors will be unable to switch from high-cost pipeline deliveries to low-cost field purchases. Even if distributors are free to search for gas, pipelines' take-or-pay obligations are unlikely to be eased, because producers able to collect high prices from pipelines for their whole output will be unwilling to sell at lower, market-based prices offered by distributors. Thus, despite its clear benefits for some buyers and sellers now excluded from the market, increased access is unlikely by itself to ease problems of producers and distributors facing high contracted prices and low demand.

Possibility of long-run benefits

In the longer run, however, increased access could contribute to more efficient and flexible working of gas markets. Allowing distributors, ultimate consumers, and producers to deal directly will create new options for buying and selling gas and opportunities to match parties in a way that shares risks more acceptably and presents incentives more effectively.

Some rigidities in gas markets could well be alleviated. Contract carriage could replace the current cumbersome apparatus in which redirecting gas requires certification of entry into a new market or authorization for temporary off-system sales. These proceedings could be bypassed by a market transaction between producers and distributors or consumers. More appropriate terms and conditions also might be devised if producers and downstream parties negotiated directly. In particular, pricing flexibility, difficult to achieve under current Federal Energy Regulatory Commission regulation of pipelines, might be accomplished in direct sales.

Greater competition also could encourage pipeline companies to be more aggressive in obtaining contract terms and concessions that allow pricing flexibility in response to changing demand. To the extent that distributors and end-users must deal through pipelines, the threat of losing sales as a result of outdated practices is diminished. If their customers can deal directly with procedures, pipeline companies will have greater incentives to renegotiate and adopt more creative arrangements.

Deregulation of natural gas field prices is likely to fundamentally change how gas is bought and sold and delivered from field to burner tip. In particular, pipelines no longer may operate in their traditional fashion as private carriers, buying gas from producers and reselling it for a profit to distributors. Instead, some form of contract carriage is probable, where producers and distributors have greater access to deal directly with one another and pipelines serve simply as transporters.

Such changes in pipeline carrier status will enhance price and output flexibility

in gas markets. So, too, will modification of current contractual arrangements between producers and pipelines and between pipelines and distributors. Yet it is important to emphasize that changes in pipeline carrier status and in current contractual practices are mutually reinforcing. Indeed, policymakers should treat them not as substitutes but as complements. Taken alone, changes in carrier status can provide only limited relief.

Authors W. David Montgomery, a senior fellow, and Harry G. Broadman, a fellow, are in RFF's Center for Energy Policy Research. The article is based on their new Research Paper, Natural Gas Markets After Deregulation: Methods of Analysis and Research Needs, *published by RFF in July (see page 15 for a description of the volume).*

(Global resources, *continued*)

new long-term agreement for Soviet grain purchases.

Finally, after two one-year extensions of the lapsed agreement, the Reagan administration and the Soviet Union, now under Yuri Andropov, in August 1983 concluded a new five-year pact. Its terms on the surface appear to be major improvements—from the American standpoint—over the initial agreement: both the minimum purchase level and the level allowable without consultation are 50 percent larger than before. But those levels, now 9 and 12 million metric tons, respectively, still are small relative to the amounts the United States wishes to sell and to what the Soviets actually have purchased in recent years. Thus, the new agreement may be interpreted as an expression of Soviet caution: twice burned by embargoes, the Soviets probably do not believe they can rely fully on what must appear to them as a capricious, not to say arbitrary, United States. And they can afford to be wary, as Soviet agricultural production is picking up after four dismal years and especially as they have effectively diversified their sources of external supply, with Canada and Argentina playing prominent roles.

Thus, U.S. food policy confronts a self-imposed dilemma. American agriculture increasingly is oriented to the export market, but important parts of that market from time to time are declared off limits for foreign policy reasons. For the future, whatever shape food policy takes almost certainly will be influenced heavily by international events only partially, if at all, under the control of U.S. policymakers.

What is past is prologue

So much for what has happened. What can we expect will happen in the near future? Any specific prediction almost certainly will be wrong, but the best forecast for global natural resources as a whole is that the situation of the recent past will continue: the whole politicoeconomic system has fairly high inertia.

Past patterns and relationships concerning food in particular may be expected to persist, with producers' interests remaining the leading element in U.S. foreign economic policy in this area. A turn toward renewed détente in U.S. relations with the Soviet Union is not unlikely, though certainly not inevitable. Indeed, the conclusion of the long-term grain agreement once again may prove an early sign of a change in the overall tenor of U.S.–Soviet relations.

There probably will be repeated episodes such as those of 1973–74 in which the run up of international food prices has a disproportionate impact on poor importers, and the question of emergency relief will arise again. The possibility of the United States using food as a foreign policy weapon again may come to the fore, and the slogan, "a bushel for a barrel," even may be revived. Jingoistic chest-thumping aside, this will remain an unrealistic notion. Although the United States currently accounts for a very large share of the world's exports in major grains, it simply does not control enough of the world's potential supply to make such a threat possible on its own. Nor do other major suppliers and potential suppliers share U.S. interests and views closely enough to make an effective "OGEC" likely.

Two premises for the future

What should the future be, if Americans could shape it as they wish? Or perhaps the question is better posed in terms of what can be done as a matter of U.S. national policy to help shape a better future.

Broadly and briefly, the answer in my view is to base U.S. policies on two premises: first, a continued commitment to an open world economy; and second, the recognition that energy, mineral, and food supplies are truly global resources. These premises lead directly to the conclusion that increases in global supply—wherever they occur—are in the long-run U.S. national interest, even though they may not be in the immediate interests of all or even particular U.S.-domiciled or U.S.-owned producers.

Some specific applications of the principle are clear. For example, it was inappropriate—not just politically unwise and futile—to try to hinder the Soviets in building the natural gas pipeline from Siberia to the western border of the bloc. Will it not increase the supply of energy to Western Europe? Similarly, U.S. administrations of both political parties have blown hot and cold on the question of making available, or denying, to the Soviet Union and other unfriendly countries U.S. oil-drilling and -exploration technologies. The U.S. Export Administration Act allows the president to restrict exports for reasons of national security and foreign policy. As *Resources* goes to press, the act is being debated in Congress preparatory to renewal. Whatever form renewal takes, one hopes that President Reagan and his successors use it sparingly and not as an all-purpose foreign policy bludgeon.

Two food policies could well serve long-run U.S. interests, although they might diverge from the shorter-run interests of American producers. The first is an increase in both the scale and effectiveness of international programs to increase food production in the Third World, especially the capacity of poorer countries to raise the outputs of their own farms. This would require more U.S. resources and leadership than such efforts have received in recent years. Second would be coordination of efforts to create and maintain an international food reserve to deal with the extra burdens that sharp short-run fluctuations in production and prices place on poor importing countries.

Finally, the most important immediate obstacle to maintaining a truly global view is the recent worldwide recession and the low growth rates and high unemployment in the industrial economies that threaten to continue through the next cyclical recovery. These circumstances stimulate protectionism, make it politically difficult for the United States and other nations to take a global view, and make it much more likely that recent behavior will serve as the model for future behavior. U.S. interests in natural resources *are* global interests, but it is difficult to see this essential truth when suffering from national myopia.

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Book reviews

The volumes selected for review in this issue of Resources *include* Algeny, *by Jeremy Rifkin;* Buying A Better Environment: Cost Effective Regulation Through Permit Trading, *edited by Erhard F. Joeres and Martin H. David; and* Economic Approaches to Natural Resource and Environmental Quality Analysis, *edited by Maynard M. Hufschmidt and Eric L. Hyman.*

Publishers who wish to submit their books for review should address a letter of inquiry to Book Review Editor, Resources, *Resources for the Future, 1755 Massachusetts Ave., N.W., Washington, D.C. 20036. Upon publication, two copies of the review will be sent to the publisher.*

The coming of biocomputers

Algeny, by Jeremy Rifkin (New York, Viking Press, 1983) $14.75, cloth.

Jeremy Rifkin, the author of *Entropy: A New World View* (1980), argues a disturbing vision of the future in *Algeny*. The industrial age of shaping inanimate material by fire ("alchemy") is about to give way to a postindustrial one of shaping living tissue by computer ("algeny"). The economic metaphor of the industrial age is the Darwinism that emphasizes brute force and decentralized competition as ways to overcome nature. It is to be supplanted by a now-emerging metaphor that stresses information, cooperation, and artificial organisms that will be prodigiously useful—bypassing nature.

Yet the new metaphor, Rifkin contends, will be as false—that is, as partial, delusive, and self-serving—as the old, a substitution of one convenient complacency for another. And the advent of biocomputers will lead to a sort of New Eugenics, a means of "creating a second nature in our image" (page 252)—thus denying the first nature simply because it is not in our image. We must, Rifkin concludes, give up the new technology.

Algeny has successive chapters on the rise of biocomputing, the functions of economic metaphors ("Deciding What's Natural: The Ultimate Intellectual Deception"), Darwinism as a metaphor for the postindustrial one, the developing post-Darwinian age, and the choices before us. The book does not deal directly with natural resources, but the resource-minded reader will have little trouble seeing its applications to agriculture, forestry, mining, energy, or environmentalism.

The book's prime virtue is an almost reckless ability to think big, to spot where conventional thought is wooly, smug, or narrow, to plunge in and suggest bracing alternatives. Rifkin has a gift, evident on nearly every page, for turning abstractions into understandable, often striking images, and for bending seeming clichés into newly interesting shapes. He lacks the compulsion for respectability that makes so much social science pompous and policy analysis boring. He is not afraid to be creatively crazy.

So *Algeny* sometimes sounds like a nut book. There is a lot of heavy breathing—"Civilization is experiencing the euphoric first moments of the next age of history" (page 229)—and thumb sucking—"Human beings have never felt very comfortable in this world" (page 40). Rifkin explains clearly why many competent biologists are uncomfortable with Darwinism, but never considers that the theory of evolution may just be going through one of its periodic retoolings—as have those other nineteenth-century intellectual products, psychoanalysis and Marxism, in recent years.

He is necessarily vague on what the details of the post-Darwinian metaphor will turn out to be. His all-or-nothing arguments for renouncing biocomputers are rhetorical and unconvincing—"Is guaranteeing our health worth trading away our humanity?" (page 233). He does not always appear to believe them—"Can any of us imagine saying no to all the great benefits that the bioengineering of life will bring to bear? Can any of us, for that matter, entertain even for a moment the prospect of saying no to the age of biotechnology?" (page 255).

But beneath the book's born-yesterday surface lies a serious, substantial effort to project the long-run effects of what plainly will be a revolutionary technology. The attempt is not totally successful, for it is hard to see how it could be. The book still is worth reading.

Reviewer Frank J. Popper, a 1982–83 Gilbert F. White Fellow in RFF's Renewable Resources Division, teaches in the Urban Studies Department at Rutgers University.

Permits to pollute

Buying A Better Environment: Cost Effective Regulation Through Permit Trading, Land Economics Monographs, No. 6, Erhard F. Joeres and Martin H. David, eds. (Madison, University of Wisconsin Press, 1983) $27.50, cloth; $7.50, paper.

For years economists have been advocating greater use of economic incentives in environmental policy. One such incentive mechanism, the transferable discharge permit (TDP), now is beginning to be used in a small way and, as a result, economists have turned from exclusive concern with the theoretical properties of such policies to the practical issues of implementation. This volume, the proceedings of a 1982 conference on TDPs sponsored by the University of Wisconsin Sea Grant Institute, discusses many of these issues.

The theoretical attractiveness of marketable permits lies in their promise of greater economic efficiency than the currently prevailing "command-and-control" approach to environmental policy. With rights to discharge pollution being bought and sold like other property, plants for which pollution abatement is difficult and expensive could purchase rights from plants that have lower costs. The result is that pollution would be controlled by those firms that have the least abatement costs. As the papers in this volume make clear, however, realizing these benefits may be tricky. Taken together, the papers make three interesting, if not always novel, points.

First, because discharges can vary considerably over space and time, a complex administrative procedure may be required to determine whether a given trade will be allowed, or to set the terms of the trade. Furthermore, numerical simulations indicate that the efficiency gains that do occur from TDPs are obtained from greater use of the assimilative capacity of the atmosphere rather than from a reallocation of emissions. That is, emissions are allowed to increase, but in a way that does not violate ambient standards. As Scott Atkinson's paper points out, this leaves open the possibility that a locally designed TDP policy can exacerbate problems caused by long-range transport of pollutants. Likewise, one does not have to be an environmentalist to worry about how often "greater use of assimilative capacity" in fact will lead to deterioration of environmental quality. In general, the writers treat the prospective use of assimilative capacity a little too cavalierly.

Second, the manner in which rights are handed out initially can influence not only the distribution of benefits but also the total benefits. Some distributions generate large windfall gains or losses for some participants, and on that account may be politically infeasible. Moreover, in most applications discussed in this volume there are only a small number of market participants. In such situations the efficient outcome may not be reached and may depend on the initial allocation of rights. Thus, the initial allocation must meet two objectives—political feasibility and economic efficiency—that may be mutually exclusive. Although this is an important point, I believe that perhaps too much is made of it. In all likelihood, the distribution of rights in any given situation will be based on the status quo—the discharge permits of existing sources under the previous regime.

Third, the efficiency and effectiveness attributable to various kinds of marketable permits are extremely case-specific, depending on the nature of the pollutant and the spatial configuration of sources. Thus, policies that work well in one context may not work in others, making it difficult to learn from previous policy applications. Though it is not mentioned in this volume, this also suggests that a policy designed for a particular situation may, over time, become increasingly inappropriate as the location of sources changes.

Like many proceedings volumes, this one is somewhat repetitive. Most of the papers are highly technical, describing in detail mathematical models or numerical simulations requiring a large investment of time and effort. In addition, at least one of the more serious practical problems of implementing a TDP policy—"paper trades"—is mentioned only once, and that time by a discussant (predictably, a regulator) decrying its neglect by other speakers. Nonetheless, this volume would reward anyone wishing to learn more about the implementation problems associated with this promising policy tool.

Reviewer Winston Harrington is a fellow in RFF's Quality of the Environment Division.

Developing the underdeveloped

Economic Approaches to Natural Resource and Environmental Quality Analysis, Maynard M. Hufschmidt and Eric L. Hyman, eds. (Dublin, Tycooly International, 1982) $50.00, cloth; $28.50, paper; $18.55, special rate for developing countries.

This conference volume addresses the concern that natural resource and environmental quality values are not being taken into account in development plans of developing nations. It attempts to make a case for the relevance of such values by presenting them in economic terms familiar to those involved in planning decisions.

The papers fall into two categories—survey articles and those with a narrower focus. For the most part, the earlier papers are broad statements of the nature of resource and environmental economics, descriptions of benefit–cost analysis and the related techniques, and comments on the relevance of these methods for developing nations. Despite considerable overlap, and the wide availability of other surveys, Hufschmidt's introductory paper and the papers by Bromley and Pearson are effective. Pearson, in particular, is persuasive that sustained development will require an effort to preserve environmental resources. These papers also offer thoughtful comments on the special difficulties in applying benefit–cost analysis in developing nations.

The more narrowly focused papers range from descriptions of case studies to discussions of institutional difficulties in planning decisions. Outstanding is Wattanavitukul's consideration of water pollution by sugar producers in Thailand. The description of the legal and institutional setting is fascinating. One wishes there were more papers of a similar nature. Three very brief papers describing the role of benefit–cost analysis in Malaysia, Indonesia, and Sri Lanka are too sketchy and too general to provoke the same interest.

A case study by Fleming, describing a reservoir project in Ecuador, and another by Thomas, on mining and land use in Australia, are reassuring in their straightforward approach. Browne's paper on the "environment of poverty," described as leading to the wasteful and destabilizing use of natural resources, is rather more unsettling. Browne effectively contrasts problems associated with economic growth, such as industrial pollution, and those associated with poverty, such as deforestation from fuelwood demand and poor health from unsanitary water supply.

Overall, the volume is somewhat disappointing. The quality and focus of the papers is uneven, as might be expected in any conference volume. Only a few would stand well alone as readings for course work. Together the papers are fairly effective, but this reviewer would have welcomed more that gave a real feeling for the planning problem in developing countries.

Reviewer Michael Bowes is the Horace Albright Fellow in RFF's Quality of the Environment Division.

Books received

Commercial Applications of Wind Power, by Paul N. Vosburgh. 272 pages. $24.95, cloth. Published by Van Nostrand Reinhold Company Inc., New York City.

New England Prospects, Carl H. Reidel, editor. $18.00, cloth. $9.00, paper. Published by the University Press of New England, Hanover, New Hampshire.

Wildlands and Woodlots, by Lloyd Irland, A Futures of New England Book. $17.50, cloth. Published by the University Press of New England, Hanover, New Hampshire.

New RFF books

The Comparative Economics of Plantation Forestry: A Global Assessment. Roger A. Sedjo. 168 pp. RFF Research Paper. $11.00. Available from The Johns Hopkins University Press, Baltimore, Md. 21218.

Throughout the world growing demands for wood and its by-products and the continuing search for new agricultural lands have accelerated the depletion of the world's forests. The gradual depletion of what was once an unlimited resource has contributed to the long-term increase in the real price of many forest products. This in turn has caused great concern regarding the cost and availability of future wood supplies.

Plantation forestry, defined as the planting, managing, and harvesting of trees for the production of industrial wood, is capable of dramatically increasing wood yields. With such yields—which are 10 to 20 times the estimated average yield on the world's forests in 1978—it would be possible to satisfy wood needs by utilizing only a small fraction of the land now devoted to forests.

The future role of plantation forestry both within specific areas of the world and in terms of its overall contribution to global wood supplies will depend in large part on the two issues addressed in this study—the economic feasibility of such plantations in various areas of the world and the long-term ecological impacts of such forestry regimes in tropical areas.

The Federal Lands Revisited. Marion Clawson. 288 pp. Hardcover, $25.00. Paper, $8.95. Available from The Johns Hopkins University Press, Baltimore, Md. 21218.

The first century of U.S. history was an active time of acquisition and disposal of federal lands as the frontier moved westward. This was followed by a period in which park and forestlands were reserved

from disposal, even while cropland and grazing lands continued to make their way into private hands. By the 1930s, the era of disposal had come to a halt. In the 1970s the recommendations of the Public Land Law Review Commission and the enactment of the Federal Lands Policy and Management Act committed the federal government to intensive, multiple-use, environmentally sensitive management of most remaining federal lands.

The changing economic conditions of the 1980s mark yet another challenging era for federal land managers and land users alike, one that Marion Clawson characterizes as a period of "consultation and confrontation." Buffeted on one side by the Sagebrush Rebels and others who urge the "privatization" of the federal lands and on the other by the environmentalists and conservationists who argue for their retention, policymakers are hard pressed to find rational solutions for the major problems facing the federal lands.

In this volume, Clawson presents a comprehensive overview of federally owned lands in the United states. Their historic and present uses are reviewed, along with current policy issues and major alternatives for their future use and management. The commodity, environmental, and amenity values of these lands are considered carefully, with specific reference to grazing, forestry, minerals extraction, oil and gas production, wildlife and wilderness preservation, watershed protection, and recreation.

As a former director of the Bureau of Land Management and a prolific writer on U.S. land and forestry policy, Clawson furnishes an updated and stimulating account to all those who have an interest in U.S. federal lands policy.

Natural Gas Markets After Deregulation: Methods of Analysis and Research Needs. Harry G. Broadman and W. David Montgomery, with Mary Beth Zimmerman. 112 pp. An RFF Research Paper. $18.00. Available from The Johns Hopkins University Press, Baltimore, Md. 21218.

Deregulation of natural gas field prices is likely to cause fundamental changes in the way gas is bought and sold; in the structure, conduct, and performance of gas markets; and in the way transmission and distribution companies are regulated.

However, it is not at all evident what these changes will be, how they will take place, or what direction they will take. It *is* clear that the natural gas industry will change considerably in the next decade and that pipelines and distributors will no longer be able to operate in their traditional fashion. It is likely that regulatory authorities also will face new decisions and problems as a result of deregulation.

To date, there has been no systematic study of downstream natural gas markets—the complex network of pipelines and distributors that moves gas from the field to the consumer. This work makes a strong case for using economic tools to analyze these markets—particularly in light of the new era that will follow field price deregulation. It pulls together the analytical methods that can be used to understand and predict some of the changes that may occur and identifies current and upcoming policy issues that may arise.

The authors relate the mechanics of natural gas production, transmission, and distribution to the economic features of the industry. They discuss the competitive structure of gas markets, the economic function of long-term contracts, the regulation of pipelines and local distribution companies, the role of interstate pipelines in a market with free wellhead prices, and the regulatory allocation of costs between jurisdictional and nonjurisdictional customers. Most important, they present an agenda for much-needed research in this area.

Current legislative efforts are far ahead of any analytical understanding of the issues and problems that will arise with deregulation. The authors point out that much more research is needed if past legislative mistakes in this area are not to be repeated. This study is a must for anyone concerned with formulating natural gas policy, as well as in the industry itself.

U.S. Interests and Global Natural Resources: Energy, Minerals, Food. Edited by Emery N. Castle and Kent A. Price. 160 pp. Hardcover, $18.00. Paper, $6.95. Available from The Johns Hopkins University Press, Baltimore, Md. 21218.

If there ever was a golden age when the United States could indulge in a dream of economic self-sufficiency, that time has long since passed.

This book focuses on oil, nonfuel minerals, and food and demonstrates conclusively that international trade in natural resources makes for a world of mutual interdependence. But nature did not distribute resources equally around the globe, and differing stages of economic development complicate the random distribution of petroleum, or chromium, or temperate climate. Geographic or economic dominance of a market can lead to cartels; market strength coupled with political hostility makes embargoes possible; natural disasters can shut off supplies; and wars, revolutions, and terrorism place the links of trade high on the list of targets.

In such a world, warn the authors, a nation is well advised to identify its vital interests and to develop policies to safeguard them. In a clear and readable style, they analyze U.S. interests and assess the extent to which foreign policy is made—or should be made—in light of the worldwide distribution and availability of natural resources and their services. Perhaps surprising to readers familiar with foreign policy or natural resources but not both, the authors show that energy, minerals, and food have markedly different foreign policy implications. These are developed in detail for each commodity and are addressed jointly in an introductory essay by the editors.

Unique in its treatment of the intersection of foreign and resource policies, this volume will appeal to generalists as well as to those with specific interests in either set of policies. Contributors include Milton Russell, John E. Tilton, Hans H. Landsberg, Dale E. Hathaway, Carl Kaysen, and McGeorge Bundy.

RFF reprint series

The following reprints of staff material have been added to the RFF reprint series. Single copies are available free on request to Resources for the Future.

201. Alternative Air Quality Policy Options in the Four Corners Region, by Fred Roach, Charles Kolstad, Allen V. Kneese, Richard Tobin, and Michael Williams. 1982. The authors examine widely differing possible approaches to the preservation of air quality, including the legislation of fees for emissions, the imposition of airshed emissions ceilings and the allocation of those ceilings over individual polluters within the airshed, the requiring of all emission sources to reduce their emissions by a uniform (proportional) amount, and the strengthening or relaxing of present technology-based regulations.

202. Energy and Consumer-Expenditure Patterns: Modeling Approaches and Projections, by Thomas J. Lareau and Joel Darmstadter. 1982. The authors analyze and project long-term trends in the pattern of U.S. household expenditures and examine the energy-consumption implications of those trends. They have utilized the social-accounting framework provided by the U.S. Department of Commerce personal consumption expenditure data.

203. The Measurement of Productive Efficiency: A Reconsideration, by Raymond J. Kopp. 1983. This highly technical paper generalizes the Farrell indexes of productive efficiency to nonhomothetic

production technology and at the same time maintains the cost interpretation of the Farrell measures. Since the generalized indexes rely heavily on recent developments in the estimation of frontier cost and production functions, several frontier models are reviewed. In addition to generalized indexes of technical, allocative, and overall productive efficiency, a variety of single-factor efficiency measures are discussed, and their applicability is illustrated with numerical examples of electric power generation.

204. Agriculture and Natural Resource Adequacy, by Emery N. Castle. 1983. The author explains why agricultural economists are Cornucopians rather than Malthusians; examines how the availability of the natural resources of energy, water, and land will affect aggregate agricultural output in the United States for the remainder of this century; and discusses public policies affecting natural resource use in agriculture.

205. The National Recreational Fishing Benefits of Water Pollution Control, by Clifford S. Russell and William J. Vaughan. 1983. The authors report on their nationwide effort to estimate the freshwater recreational fishing benefits of water pollution control. Their forecasts are based on four scenarios.

206. Understanding Nonrenewable Resource Supply Behavior, by Douglas R. Bohi and Michael A. Toman. 1983. Decisions concerned with finding, developing, and extracting nonrenewable resources are dynamically interrelated in complex ways. Economic theory describes this process and offers useful insights, but gaps exist between theory and empirical applications that hinder our understanding of how supply responds to changes in economic incentives. Consequently, the authors offer some recommendations for further research.

207. Key Elements Common to Critical Issues on Engineering Materials and Minerals, by Hans H. Landsberg. 1983. In this paper presented at the Seventh Biennial Conference on National Materials Policy, the author puts into perspective the current concern over adequacy and reliability of mineral supplies, and sketches the major problems and their remedies.

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