Opportunities for Redesigning Policies for Agriculture, Trade, and the Environment

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The previous chapters have demonstrated that global integration, expanding and changing world agricultural markets, and heightened environmental concerns are defining new policy challenges and opportunities for the United States. These trends manifest themselves in global markets that demand growing amounts of value-added agricultural products; an emerging environmental agenda that extends beyond traditional conservation concerns; and an expanding research agenda that increasingly emphasizes environmental protection, food safety, marketing and trade, and profitable, yet environmentally sustainable agricultural systems.

Unfortunately, federal policies and programs affecting the agricultural sector have not changed sufficiently to address these new concerns. Indeed, they conflict with the new developments in significant ways. They promote production of bulk commodities and hinder possible opportunities for U.S. farmers in fast growing, value-added export markets. They divert major resources to soil conservation while other issues of significance—water quality, wildlife habitat, and soil quality—remain relatively neglected. Almost two-thirds of agricultural research funding is devoted to increasing farm output, but more output will mean more federal subsidies to export surplus crops, and still more federal funds to "idle" land to control surpluses.

As the United States moves toward the year 2000, and as continuing budget pressures constrain traditional subsidy solutions, government must explore innovative approaches to these dilemmas. Furthermore, tensions between agricultural policies and trends in both trade and environmental spheres create costly inefficiencies. Seeking complementary and mutually reinforcing policies for agriculture, trade, and the environment could not only

lessen budget pressures but also help ensure that the nation's policies are oriented to the future, not anchored to the past.

Seeking complementarity would involve:

- synchronizing domestic trends with global forces,
- targeting program resources on priority areas,
- encouraging development of technologies that serve multiple objectives, and
- using markets or market-like mechanisms wherever possible.

This chapter presents policy options for agriculture, trade, and the environment that illustrate how policies and institutions can be complementary rather than in conflict. As the United States heads into the 21st century, such complementarity could have a key influence on the role and standing of U.S. agriculture in an ever-expanding global economy. Moreover, seeking complementarity among agricultural, trade, and environmental policies will permit the United States to seize the opportunities of global market expansion while protecting and advancing domestic goals related to environmental quality as well as the competitiveness of the agricultural sector. Options to modify existing programs and legislation, or to introduce new programs and legislation that pursue complementarity for agriculture and trade, agriculture and the environment, and trade and the environment are examined in turn.

POLICY OPTIONS FOR AGRICULTURE AND TRADE

A paramount message of this report is that today's farm programs no longer serve the needs of the agricultural economy and the nation. Farm programs are costly, many work at cross purposes with each other, and they are aimed at achieving goals that many Americans no longer consider a priority. Production subsidy programs, for example, create surpluses that require costly export subsidy programs to dispose of them. To stem production of surplus crops, millions of acres are laid idle at government cost—and production of other products that are in ever-greater demand overseas is stymied. Acreage bases concentrate the application of fertilizers, pesticides, and other inputs on fewer acres, increasing risks for the environment. All the while, research programs concentrate on generating more crop output, and little heed is paid to solving newer problems relating to trade and the environment.[1]

A new approach is needed for the agricultural sector—one that aims at bringing about greater harmony among agricultural production and new budget realities, the environment, and international markets. This is not to say that traditional goals should be abandoned completely. As its economy grows, the United States continues to require abundant supplies of safe and affordable food and fiber. But the tenor and realities of the times have changed, and government programs must change with them. Many citizens now view food safety, for instance, as a major concern, making the impact of farm programs on chemical use in agriculture as important as their impact on farm income and farm exports. Citizens are also demanding greater environmental protection, which puts more pressure on management programs. Income levels of farm households are now on a par with nonfarm households, raising questions about programs that transfer government payments to the farm sector. And with regard to trade, consumer demand abroad now favors a mix of U.S. agricultural exports that includes more horticultural and highly processed food. Consequently, the composition of agricultural goods has become as important to reducing the nation's trade deficit as the expansion of export tonnage but is not reflected in

[1]Research to increase output of price-supported crops continued long after surpluses accumulated at least partly because farmers were protected from losses on increased production. Research institutions were in turn protected from the normal effects that producer losses would have had on public support for such research projects. How research allocations in land grant universities would have changed in the absence of price support programs is open to varying interpretations ranging from "not much" to "a lot." This assessment did not attempt to complete an in-depth evaluation of this issue.

federal policies on export promotion. To take greater advantage of evolving opportunities for expanded trade, farm production patterns must be allowed to respond more to market forces rather than being constrained by traditional farm commodity programs. Such flexibility is consistent with new budget realities that favor reallocation, if not reduction, of funds for agricultural programs.

One alternative for moving toward more market-oriented farm programs would be to continue the trends established in the 1985 and 1990 farm bills. This approach would pose few surprises for market participants. After 60 years, commodity programs have become well known and their impacts can be anticipated. Changes in weather and variation in export demand remain the primary sources of variation in program costs and farm incomes. Rising levels of productivity also affect program costs, as output pushes ahead of markets and requires budgetary expenditures on storage and export disposal programs. Coupled with the budgetary costs for direct production subsidies, such expenditures can be sizable and difficult to estimate precisely, given the uncertainty of future default rates on government-guaranteed export loans (chapter 3).

Extending current commodity programs would ensure an abundant food supply for the nation and modest increases in food prices. Budgetary costs for price and income support programs would be expected to average in the $9 billion to $11 billion range.[2] (Expenditures averaged $11.3 billion for fiscal years 1991-95.) The value of farm exports would continue to grow, with steady gains coming from increased sales of value-added food exports and occasional upswings in commodity exports. Bulk commodity exports would respond to variations in weather in other countries and changes in internal policies. Aggregate farm income would remain fairly constant, especially in real terms, with sudden boosts in the occasional year of drought or other natural disasters overseas. Per capita farm income would increase as farm numbers decline.

There are, however, numerous other approaches to farm legislation beyond an extension of current programs, ranging from the elimination of direct payments and price support programs to the targeting of price support programs toward small and moderate-size farms or environmental enhancement. Which kinds of farm programs should be implemented, how much funding they should receive, and where they should be targeted are issues to be decided through the legislative process. OTA's goal, in the following sections, is to outline a selected set of available options to enhance policy discussions.

ISSUE 1: *Harmonize Farm Commodity Programs and International Market Trends.*

U.S. farm commodity programs have at times hindered efforts to expand agricultural trade. As discussed previously in this report, the United States implemented large acreage reduction programs to hold down production of major crops (e.g., wheat, feed grains, rice, and cotton) throughout most of the 1980s. To ensure that acreage would be reduced, the government required farmers to cut back on the amount of land they planted in return for federal payments. The programs had an unintended effect on trade: along with reducing acreage of the program crops, they also reduced acreage of soybeans—a nonprogram crop—which were in great demand in international markets. Competitor countries took advantage of those markets, expanding their acreage of soybeans to meet global demands. Similarly, the United States has continued to implement commodity programs that focus land resources very

[2]The Congressional Budget Office (CBO) reported on Mar. 6, 1995, in a personal communication, that budget expenditures for CCC net outlays for commodity programs are expected to average $8.4 billion from FY 1995 to FY 2000. In arriving at this figure CBO excluded disaster payments, included the effects of the new Uruguay Round agreement provisions, assumed that there would be no wool and mohair payments after FY 1996, and assumed that dairy expenditures would remain low.

heavily on a few bulk commodities—even as global markets shift away from bulk commodities and toward more trade in value-added food products.[3]

The 1990 farm bill gave farmers some additional flexibility as to how they could use their program acres, but only modest changes in land use resulted. An important goal of the bill—a substantial increase in soybean acreage—was not achieved. Some expansion of value-added food exports occurred, but not at rates equal to the expansion in global markets (chapter 3). If the United States is to fully use its natural advantages in agricultural production in the future, additional changes in farm legislation are required. Three options are examined below.

OPTION A: ***Phase out all income transfer programs for agriculture between 1995 and 2000, and allow land use and exports to respond to signals from national and international markets.***

Income transfer programs (also known as target price or deficiency payment programs) provide farmers with direct payments from the federal treasury. Their purpose is to stabilize farm income by protecting farmers against fluctuations in commodity prices. When the market price of a commodity rises above its target price, a producer receives no payments. When market prices are below target prices, the government makes payments to producers to compensate for the difference between market prices and target prices. In other words, income risks are shifted from farmers to taxpayers at large.[4]

The impact of eliminating target price payments over a five-year period would be concentrated on farmers producing target price crops. As the economic returns for these crops declined, some farmers in higher-cost regions would discontinue production, shifting land and capital resources to other crops and to livestock production. Other farmers in low-cost production areas might expand production as their counterparts in high-cost areas stopped planting these crops. Commercial farmers would make the adjustments relatively quickly, where adjustments were economically beneficial. Part-time farmers might be less responsive, since most depend less on income from farming and are perhaps less attuned to commodity market changes.[5]

For the sector as a whole, the impact on farm income from eliminating direct government payments would be modest. As illustrated in chapter 2 (figure 2-5), the decline in direct government payments between 1987 and 1993 was more than offset by increases in cash receipts. With farm numbers declining between 1987 and 1993, average per-farm income from farming activities in-

[3]Producer payments under commodity programs have distorted cropland use in agricultural production, although estimates of the amount are lacking. What is clear is that program payments have tied too many acres of cropland to surplus crops such as wheat, rice, cotton, and feed grains, and resulted in acreage diversion programs which, in turn, left fewer acres available for crops, such as soybeans, that have experienced growing global markets for products. The cost of this distortion may be significant. Had soybean acreage, for example, continued to expand in the 1980s to meet growing global markets, instead of declining, the need for acreage diversion programs would have been diminished or even eliminated. Of course, other countries' policies relating to export subsidies also played a role in these trends and international trade negotiations were used to reverse these directions. However, trade negotiations turned out to be a rather weak tool for maintaining U.S. global market share for soybean products.

[4]Established in the 1973 farm bill and extended in the farm bills of 1977, 1981, 1985, and 1990, target price payments are calculated as the difference between the target price and the market price (or the loan rate, whichever is higher) of a commodity, multiplied by a farmer's eligible production, where eligible production is based on a farmer's historical acreage base and yield history. After the payment is calculated, a treasury check is issued to the farmer for the amount of the payment. In 1994, for example, the target price for wheat was $4 a bushel and the projected target price payment was 85 cents a bushel. A farmer with 20,000 bushels of eligible wheat would have received a $17,000 payment from the government.

[5]The 1995 *Economic Report of the President* notes that about one-third of all farmers receive payments. "Moreover, two-thirds of program payments go to the largest 18 percent of farms—even though the average income of these recipients is triple that of the average U.S. household (p. 142)."

creased over this period. When rising income from off-farm sources is included with farm income, both U.S. Department of Agriculture (USDA) and Census Bureau data indicate that farm households earned incomes, on average, that were equal to those earned by the rest of the nation's households (chapter 2). This trend would likely continue with a phaseout of target price payments. Cash receipts, which rose by an average of $5.3 billion annually between 1987 and 1993, would rise as exports, industrial uses, and other uses of farm commodities increased. The increases would accrue to farms producing food items in growing export demand or commodities for expanding industrial uses.

Under a phaseout of direct payments, incomes on larger farms would likely decline the most. The current distribution of payments favors larger farms, although target price crops are a smaller part of the overall output for many of these farms than for smaller farms. Losses for the larger farms would be mitigated by income from other sources, such as nontarget price crops and livestock products.

As noted above, some indication of the aggregate impact on farm income can be ascertained from the results of the 1990 farm bill. That legislation lowered the percentage of program acres on which payments were made from 100 to 85 percent. Aggregate farm income showed no noticeable reduction as a result of the change. Although the elimination of farm program payments would not be achieved as painlessly, especially for farmers producing target price crops, the impact on aggregate farm income would be moderate if phased in over a five-year period. The impact would be relatively mild for farmers who are flexible and able to shift some of their resources to producing other crops.

Land values would decline with the elimination of programs benefits, especially in the initial period of uncertainty following the establishment of such a policy. The real price of land, as opposed to the nominal price, might decline for a number of years until production patterns fully adjusted to market forces. The decline and duration would depend partly on how aggressively the United States took advantage of opportunities for exporting items that are in growing demand (such as fruits and vegetable, red meats, and oilseed products) and partly on whether commodity support programs were withdrawn suddenly or phased out gradually.

Export composition would be affected by eliminating production payments. Some reduction in export subsidy costs could be expected as the incentives for producing surplus crops declined. The mix of crops planted and harvested would change: fewer acres of program crops would be planted in regions with fewer natural advantages and more acres in regions with greater natural advantages. For example, wheat production would tend to be concentrated more in the Great Plains and corn production in the Corn Belt, as land-idling programs became less attractive to growers in these regions. Production would be discouraged in other regions where acreage has expanded to take advantage of programs benefits.

As acreage was concentrated in areas of natural advantage, the average costs of production would decline, making the United States more competitive in global markets and improving economic conditions in rural areas. More acreage in production would mean more purchases of inputs and other products, which in turn would strengthen tax bases and other institutional systems. The condition of streams and groundwater might, however, worsen in areas where more crops were grown, if erosion and applications of chemical fertilizers and pesticides increased.

The budgetary implications of eliminating direct payments for farmers under commodity programs are significant. In 1993, direct payments amounted to $8.6 billion of the $16.0 billion spent on price and income support programs; in 1994, $4.6 billion was spent on direct payments, out of a total of $11.8 billion. Direct payments are expected to total $5.0 billion in 1995, with total costs for farm programs set at $9.8 billion. (Direct payments are payments made to farmers under target price programs, marketing loan programs, and other minor crop or livestock programs. Additional costs for storage, interest, and other expenses for operating storage and export disposal pro-

grams are not included in direct payments, but are included in the total amounts spent on price and income support programs. These other costs would decline if the incentive to produce surpluses were eliminated.)

There would be little impact on food prices from a withdrawal of direct government payments. Less production of target price crops in less advantageous areas would be offset by more production in areas of natural advantage. Over time, shifts in production patterns would lead to fewer surpluses, fewer export subsidies, and smaller expenditures for disposing of surplus commodities. If export programs continued to be operated aggressively with smaller supplies, food prices would increase more, as they are linked to export subsidy programs—a point driven home after the severe drought of 1988. With export subsidy programs operated aggressively in 1989 and 1990, consumer food prices increased 5.8 percent each year, well above normal increases.

The impact on farm numbers, farm size, and farm structure is difficult to forecast. Most smaller farms depend primarily on income earned off the farm, and the situation would not change if direct government payments were eliminated. The total number of farms, however, would likely continue to decline.

OPTION B: ***Phase out both commodity loan and storage programs and direct income transfer programs between 1995 and 2000.***

Other major income stabilization programs extended to agriculture are nonrecourse loan and storage programs. These programs are designed to ensure the orderly marketing of farm commodities by reducing the amount of commodities coming to market at harvest time and increasing marketings at other times during the year. The government offers farmers loans based on the quantity of their commodities and equal in value to a specified support price multiplied by the quantity of commodities. The stored commodities act as collateral to secure the loans, and when the loan is due, the grower may pay off the loan and reclaim the commodities or turn over the commodities to the government as full payment of the loan, regardless of the price and value of the commodities. If the commodities are valued at less than the loan, the government absorbs the loss (hence the term "nonrecourse loans"). Another variant, the marketing loan program, allows farmers to repay loans at world prices, which generally are lower than U.S. prices. Losses on loan and storage programs will total $4.0 billion for fiscal years 1991 through 1995.

The elimination of loan and storage programs would increase instability in farm commodity markets, although the degree of instability is difficult to estimate. Certainly, some instability would be offset by the many new marketing arrangements that have evolved in recent years, such as futures markets, contract farming, vertical integration, and forward sales through elevators and other private firms (chapter 2). All such arrangements have become stabilizing mechanisms that even out sales throughout the marketing year. Nonetheless, the uncertainty accompanying the end of government-sponsored stabilization programs would have marked effects. Farm markets have not been free of government involvement for more than 60 years, and there are few, if any, farmers or other market participants who can even recall farm commodity markets in which the forces of supply and demand alone established prices and determined sales. Global demand has become more important, increasing the importance of factors such as weather on other continents (and, especially, in the southern hemisphere). At the same time, other factors such as improved global communications have diminished the impacts of weather, and of new seed varieties, by keeping all market participants better informed. None of these factors pertained when markets were last free of direct government influence.

The greatest impact of eliminating commodity loan and storage programs over a five-year period would be the adjustments required of individual growers and other market participants. No longer would farmers who place commodities in storage and file for a commodity loan with a U.S. Department of Agriculture (USDA) agency be able to use

such a simple marketing plan. Marketing decisions would be more complex, involving greater awareness of trends and events occurring at home and overseas. In the initial period, it is quite likely that market prices would fluctuate more, and farmers would find it necessary to develop new marketing techniques. With a few years of experience, the variability in markets and market prices would be expected to diminish as private stabilizers (e.g., vertical integration, future sales arrangements, contract farming, hedging on futures markets, and so forth) replaced government mechanisms.

The economic impact of this option is difficult to estimate with accuracy, and the behavior of the private storage trade is difficult to judge. Available studies tend to examine relatively small changes in loan rates rather than their elimination. Such estimates probably are not very good guides to the events and trends that would transpire with the end of stabilization programs. A five-year phaseout of these programs would give all sides time to analyze conditions and take steps to protect their own interests. For some, that might mean building storage facilities. For others, it might mean developing new marketing relationships with local elevators or other agribusiness firms. For all farmers, it would require more attention to market details. Planning for marketing of crops would become as important as planning for planting and harvesting if loan and storage programs were eliminated.

The largest economic impact of this option would fall on farmers without the capacity to carry stocks of commodities beyond harvest time. These farmers would receive lower prices and lose income if they were forced to sell at harvest time. Any impact on land values would follow from the impact on crop prices. If relatively few farmers increased their marketings at harvest, the impact would be small. In general, though, land buyers would reduce risk by offering less for land, which could result in lower land prices until growers gained experience with open markets. Depending on the degree of added price variability, consumers might see some additional fluctuations in food prices.

Budgetary costs for loan and storage programs would be reduced, saving up to $4 billion between 1995 and 2000. The composition of agricultural exports would change as commodity programs gave less support to production of price-supported crops; fewer surplus commodities would mean lower expenditures on export subsidies. The impact on rural communities would vary. There would be losses in areas where commodity programs now induce farmers to maintain acreage of crops against the forces of natural advantage.

OPTION C: *Target commodity loan and storage programs to small and moderate-size farms.*

The major impact of eliminating loan and storage programs would fall on farmers who could not carry their commodities beyond harvest time in years of unusually low prices. These farmers would be forced to sell their commodities at the lowest part of the annual price cycle, to earn funds to pay for harvesting and other operational costs. They would thus accept losses on crops that, if held for a few months, might be sold for higher prices. Scenarios such as this originally led to the establishment of USDA's Commodity Credit Corp. (CCC), which funds current loan and storage programs.

An alternative to eliminating these programs would be to limit access to them, by placing a cap on the amount of commodities that could be placed under loan by any one farmer. The cap could be set at various levels, although a limit on the average amount of wheat, corn, cotton, rice, or soybeans grown on farms producing those commodities would seem reasonable. If the average wheat farm, for example, harvests 300 acres of wheat, with an average yield of 40 bushels per acre or 12,000 bushels of wheat, the loan program could be limited to placing this much wheat under loan at the 1994 loan rate of $2.58 per bushel. If the average corn farm harvests 200 acres of corn, yielding 125 bushels per acre or 25,000 bushels of

corn at the 1994 loan rate of $1.89 per bushel, the loan program could be limited to placing this quantity of corn under loan annually. Other crops could have quantity limitations that reflect average farm size.

Placing limits on eligibility for price support loans would break with tradition. Although limits have been imposed on direct payments to farmers from the government, loan and storage programs have remained open-ended. As farm size increased and productivity rose, the quantities that any one producer could place under loan gradually increased. However, increased eligibility did not result in an automatic increase in budget costs. Stocks accumulated in one period have been sold at a gain in a later period. For example, following the drought of 1988, CCC price support operations returned to the government $926 million over costs in FY 1989 and $399 million over costs in FY 1990. These gains were more than offset in FY 1993, however, when losses on price support operations amounted to $2.1 billion, and in FY 1994, when losses were $621 million.

Under this option, small and moderate-size farms would continue to be eligible for full loan coverage, while larger farms would be forced to turn to other price stabilization methods and other sources of credit. One result might be that farms would tend to diversify their cropping patterns, so that a maximum amount of several crops could be placed under loan. For example, a large wheat farm might plant part of its holdings in another crop, so that it would be eligible for loan coverage. In such circumstances, it might be necessary to place an upper limit on the total amount of loans that the CCC would give to any one farmer. Other federal entities impose such limits: the Small Business Administration, as an example, sets a loan limit of $500,000 for any one business. A similar limit for any one farm for all commodity loans would not be unreasonable.

The economic impact of targeting loan program benefits would be modest. Small and moderate-size farms would retain a substantial degree of stabilization. Larger farms would turn even more to forward contracting, hedging, and other private risk-reduction alternatives. Land values would be relatively unaffected. Budget outlays on price support programs would be less than the $4 billion spent between fiscal years 1991 and 1995. As long as loan rates were held below market prices, farmers would not turn over large amount of commodities to the CCC. Exports of commodities would be modestly encouraged. Large farms with large quantities of ineligible commodities might tend to sell more commodities at harvest time, which could lower annual average prices and increase international competitiveness. Alternatively, CCC loan programs might be less important to these farms and limits on loan size would therefore have little effect. The impact on farm structure would be modest, although risk would increase for larger farms, which could discourage concentration of acreage in fewer hands. If the number of farms stabilized to a greater degree, rural communities would benefit.

ISSUE 2: *Align export promotion programs and global agricultural markets.*

As noted throughout this report, the composition of world food trade has changed, and international markets now favor higher valued food items. The share accounted for by consumer-oriented food products rose 17 percentage points between 1980 and 1993, and the share accounted for by intermediate food products increased 3 percentage points. In contrast, the share accounted for by bulk commodities fell by 20 percentage points, from 49 to 29 percent of total global trade. Over the same period, U.S. export shares also changed: consumer-oriented food products rose 23 points and intermediate food products rose 3 points. The share accounted for by bulk commodities declined 26 points, from 70 to 44 percent. In January 1995, USDA reported that "[h]igh-value product exports reached $25.9 billion, or 60 percent of total export value in fiscal year 1994, up from a 56-percent share the previous year." The shift also had a regional component. Asia surpassed Europe as the main market for U.S. agricultural exports in 1978 and slowly expanded its share of U.S. exports in the intervening years.

Such a large change in the composition of world food trade in the course of only a decade has placed the United States, with its heavy emphasis on bulk commodities, at a disadvantage. Large export subsidies were required to dispose of the surplus commodities that were being produced under the incentive of domestic farm programs (chapter 3). As commodity exports shrank in the early 1980s, farm income declined and rural land values dropped sharply, creating crisis conditions across the grainbelt and raising questions about the effectiveness of export promotion programs. A subsequent assessment of the programs concluded that "USDA's allocation of market development funds has sometimes taken place without sufficient regard to maximizing the effectiveness of these expenditures with respect to either expanding exports or benefiting agricultural producers." (See chapter 2.)

While the evidence gathered in this study suggests changes would be useful, continuing market development and export promotion programs with their current emphasis on bulk commodities is the course of action that holds the least uncertainty for the nation. However, it poses the weakest prospect for export growth in the food sector. Commodity exports may boom in an occasional year but the longer term trend is toward expanded global trade in value-added food products (figure 2-7). Extending the current export expansion strategy would represent the least controversial approach from the standpoint of commodity organizations and other export interests. Budgetwise, market development and export promotion programs would require about $250 million dollars annually, or approximately $1.25 billion from 1995 to 2000.

This study includes three other options for ensuring that promotion programs provide maximum benefit in terms of export earnings. A prerequisite for all of the options is more and better marketing research. Less than 5 percent of all public funds for agricultural research is allocated to domestic and international market research, and little, if any, of that amount is directed toward international markets. The dramatic shift of world trade away from bulk commodities and toward value-added items went unnoticed for nearly a decade due, in part, to a lack of research on international markets. For the United States to become proficient in marketing food to international markets, it must become more knowledgeable about countries' internal conditions, about their food tastes and taboos, and about the cultural habits that shape food consumption. Then it must shape marketing programs to match other countries' needs and desires. Such work represents a major challenge for the research community, as well as the business community, in the future.

OPTION A: ***Reorient market development and export promotion programs toward products that global markets demand.***

Improving the effectiveness of export expansion programs requires a shift in emphasis and budgetary expenditures. Currently, export promotion funds are used to dispose of surpluses produced in response to commodity program incentives. If the full cost of disposing of these surpluses were totaled (including expenditures for production subsidies, market development programs, export credit costs, and export subsidies) for exporting the last several million tons of each subsidized crop, the result would likely be net costs, not net benefits. To ensure that there are net benefits to exporting agricultural products, the United States needs policies that match those products more closely with demand in evolving markets. This new approach would require changing both the commodity programs that influence the structure of farm production and the manner in which export promotion programs are operated.

The production system can be improved by allowing market prices to have a greater influence on production levels. Target prices that are frozen over a period of years are not appropriate guides for determining the composition of farm output from year to year. Such prices have nothing to do with supply and demand, and therefore may guide production along paths that have no market relevance. More appropriate guidance can be pro-

vided by international market signals, but they must be acknowledged and understood by more farmers and/or exporters. To that end, it is important to broaden the base of current knowledge about foreign markets, and to expand the pool of knowledgeable persons and firms involved in exporting. More active participation—not only by bulk commodity exporters, but also by livestock and specialty crop exporters, exporters of semi-processed-processed commodities, and exporters of highly processed food products—is essential.

One way to achieve this aim would be to revise the program evaluation process, adopting a zero-based budgeting approach for export promotion programs. Exporters would have an opportunity to submit proposals for funding projected activities over a five-year period. Proposals accepted would be funded for those five years, and funding would be phased out over a second five-year period. The primary goal would be to make export promotion programs more like pilot programs than permanent entitlements. A secondary goal would be to make federal funding available to a broader range of agricultural interests, with the prospect of maximizing export gains for the nation and for the agricultural sector. It is worth noting here that the nation has invested billions of dollars in developing a highly efficient agricultural sector and retains an interest in maximizing the role agriculture can play in reducing the nation's trade deficit. With this in mind, it seems reasonable that a full evaluation of market development and export expansion programs should be carried out to determine their current effectiveness.

If this option were adopted, a private-public cooperative arrangement would be established along the lines of the traditional market development programs, but with a broader participation base. The goal would be to take advantage of all sources of information, both public and private, to discover new market opportunities that may accrue as incomes rise in the newly industrialized countries, as populations increase in developing countries, and as changes in government regulations take place in the hundred-plus countries covered by the General Agreement on Tariffs and Trade (now the World Trade Organization or WTO).

The budgetary gains that would accrue from pursuing this option are modest. Funding for traditional export promotion programs currently totals about $250 million annually. Export subsidies under the Export Enhancement Program cost around $1 billion annually (even though the cost will decrease, as stipulated in the Uruguay Round Agreements, or URA). Expenditures for traditional market development programs total about $37 million. The relatively new Market Promotion Program has operated with a $200 million budget. Revising these programs as OTA suggests would not produce major budget savings. Instead, the major benefits would come in the form of improved program efficacy and greater opportunities for all U.S. agricultural exporters. Overseas markets are currently expanding to include a full range of food items, from bulk commodities to the thousands of food items now available in American supermarkets. A new approach would offer U.S. exporters the chance to compete more effectively in those markets.

This proposed change in approach would require a substantial change in philosophy. Increased exports would have to be seen as a means of balancing trade accounts, rather than as tools to improve specific sectors of the economy. Private business would be encouraged to open up new markets to increase export earnings for the nation, rather than boosting the earnings of a commodity group or the corporate earnings of an export company. Continuing trade deficits and the transfer of national wealth that it entails should be adequate incentive for the nation to revisit not only agricultural export promotion programs, but also the basic philosophy that underlies all U.S. export expansion policies.

OPTION B: ***Eliminate government-funded export promotion programs and turn over market development activities to private companies.***

Market development programs for agricultural commodities began during an era of commodity

surpluses that followed World War II. Production had expanded to meet war needs and the end of hostilities brought a drop in global shipments, as Europe and Asia slowly resumed producing their own food. The decline had a heavy impact on U.S. farmers, who had geared up production to help the wartime efforts of the nation. As commodity stockpiles grew, every possible source of demand was examined, with the goal of getting rid of some amount of American grain or cotton. Private organizations representing wheat growers, cotton farmers, and producers of other commodities were encouraged to set up overseas market development programs. Their efforts focused on introducing American farm products to buyers in other countries. Over time, their activities broadened to include the establishment of feed mills, flour mills, bakeries, and other operations that would use bulk commodities from the United States.

Times have changed. The small organizations spawned by government-sponsored market development programs have become major organizations, using check-off funds from producers to finance activities. Federal funds still flow to these organizations to support activities from an earlier era. Most representatives of these organizations would probably argue that any reduction in federal funds would make them terminate their overseas market development activities. Although an immediate reaction might be that any cutback should not be condoned, further examination might conclude that there are few buyers around the globe who do not already know that the United States is a major supplier of bulk commodities. Furthermore, sales of bulk commodities are largely, if not totally, independent of traditional market development activities. Sales are arranged and concluded by large multinational corporations that also provide trade servicing activities if problems arise.

As the nation faces tightening budgets, the traditional market development programs of USDA could be reexamined, with the intent of phasing out government support from 1995 to 2000. If representatives of commodity organizations were still required to be stationed in overseas posts, federal support could be forthcoming in different forms. (As an example, check-off funds for paying costs of market development operations by farmers could be made tax deductible.) But if traditional market development programs were phased out, it is likely that many traditional market development activities would cease. By the same token, it is doubtful that bulk commodity exports would be affected very much. The most important impact would be the loss of mutual support that now exists between commodity organizations and the foreign arm of USDA. The current working relationships are excellent and a good example of how government and private nonprofit organizations can work together. Nevertheless, good working relationships do not substitute for serving the broader public interest.

This option calls special attention to the need for continuing trade negotiations to gain access to other country markets, and for discouraging the use of export subsidies globally. No single country can afford to eliminate market expansion programs, although countries can reassess which commodities or products will gain the most from promotion efforts.

OPTION C: ***Encourage the adoption of state-of-the-art computerized information systems to improve the process of transmitting overseas trade prospects to U.S. food exporters.***

Global trade, like all other business activities, has increased its tempo in recent decades. There are more suppliers of any given item, and there are more buyers in more countries. Exporters must compete with suppliers from other countries to satisfy foreign buyers, who have many options available for filling their needs. In these circumstances, the time that elapses between the discovery of a trading opportunity and the development of an offer to sell must be minimized. Many large companies save time by locating personnel overseas, but many smaller companies do not have the resources necessary for covering the large number of countries now engaged in agricultural trade.

One legitimate function of government, given the need to reduce the nation's trade deficit, is to assist smaller companies and firms in discovering

overseas trade opportunities. Such a program already exists within USDA: Foreign Agricultural Service officers stationed in approximately 70 countries send back trade leads for U.S. businesses. As communication technologies continue to improve, the system should be updated to ensure that U.S. suppliers are provided with information about trade opportunities in the most timely fashion possible.

As an initial step toward implementing this option, congressional hearings could examine how the system currently operates, evaluate how well trade leads are being transmitted from foreign sources to U.S. exporters, and consider ways of using the information highway to improve the effectiveness of the program. The adverse consequences of updating the system would, of course, be the costs of purchasing new communications equipment and training personnel to operate it. Such training is crucial for persons who, as part of their jobs, must adjust to the constant flow of new technologies out of research laboratories.

ISSUE 3: *Develop a new approach for stabilizing grain supplies during years of drought or other natural disasters.*

Less U.S. government involvement in setting crop production and storage levels would mean less protection against unanticipated shortfalls in crop production, either in the United States or in other countries. Such protection has been an inadvertent result of the loan and storage programs used to support domestic commodity prices. As noted in the previous section, storage programs were originally intended to provide farmers with an alternative to selling all their crops at harvest time, when prices are low. In practice, however, storage programs became a market of last resort for the surpluses that were produced over much of the period from 1933 through 1993. The result was large carryover stocks in many years, which added to government costs but also ensured that the nation would have an adequate food supply, even when drought or other weather-related disasters struck.

U.S. grain production currently exceeds domestic needs by such large margins that even such calamities as the drought of 1988 and the flood of 1993 were barely felt by the nation's consumers. The risk of supply shortages does, however, loom over consumers in other countries that import a large proportion of their total food supplies. While American consumers might face higher food prices during a global food shortage, foreign consumers—especially low-income consumers in developing countries—could face starvation. In effect, then, the insurance benefits of U.S. carryover stocks now go in part to foreign countries, while the costs for carrying those stocks are borne at home. Like other agricultural policies established decades ago, policies regarding stockpiles need to be evaluated in the new marketing situation that now faces agriculture.

Continuing agricultural storage programs is still feasible, unless budgetary restrictions become too severe. Their annual cost in recent years has approximated $800 million, which includes costs for purchase, storage, transportation, and disposal of stockpiles. Storage programs could be maintained with or without other facets of commodity programs, although the amount of stockpiles could become burdensome without production controls. Other options for managing stockpiles are developed below.

OPTION A: *Establish an international grain reserve with special drawing rights, limited to nations that contribute to the maintenance of stockpiles.*

One option for lowering the risk of future food shortages is to shift from domestic food reserves to international food reserves, a process that has already partly occurred. In 1972, the United States carried 34 percent of global grain stocks; by 1994, the U.S. share was 25 percent, on a par with its 23-percent share of world grain production. The memory of food shortages during the early 1970s and other influences have led to larger stockpiles in other countries. But there remains a question of whether these stocks would be shared in the event

that other countries suffered intense food shortages.

The major dilemma posed by maintaining an international grain stockpile is how to share the burden of costs and benefits. One option is for the United States to undertake international negotiations under the auspices of the United Nations, with the goal of establishing an international grain reserve. Countries could be allotted drawing rights in proportion to their contributions to establishing and maintaining the stockpile. Alternatively, an international institution similar to the International Monetary Fund (IMF) could be established to maintain stability in global food supplies. Some form of SDRs (the special drawing rights used by the IMF) could be used for grain rather than for currency. A third alternative would be to turn the CCC into a quasi-government corporation similar to the Farm Credit Administration and sell shares to interested nations, who would then have drawing rights on CCC stocks during global shortages. A fourth alternative would be for grain-exporting countries to band together and jointly carry a minimum level of grain reserves to be sold only during shortages.

Whichever option might be considered, the process of establishing an international grain stockpile would involve determining the proper level of stocks to cover expected variations in global grain production. Some indication can be derived from past experience. For example, a 1972 decline in world grain production of 30 million tons led to very serious world food shortages and a record increase in domestic food prices. In 1993, world grain production dropped 80 million tons, but had little effect on world food supplies. Large carryover stocks in other countries were, in part the reason that 1993's low production levels did not create havoc in world food markets.

Growth in world population (and hence vulnerability to grain shortages) will take place mostly outside the United States. The impact of future grain shortages due to bad weather will generally fall on other countries that have high population-land ratios. Initiating international stockpile discussions is one way of drawing attention to the likely impacts of future grain shortfalls. The alternative is to allow weather-induced shortages to focus attention on the issue.[6]

OPTION B: ***Phase out all government-initiated storage programs and allow market expectations to set the level of carryover stocks.***

The original establishment of grain stockpiles was inadvertent, the outgrowth of price-support programs that were established not to build stockpiles but to support farm prices and incomes. In the intervening decades, stockpiles of grain have become an end unto themselves, with grain growers receiving storage payments and, occasionally, windfall profits when world shortfalls cause prices to escalate sharply. The return of stockpiles to private hands would change the economic landscape in which commodity prices are determined, although the prices themselves might not change. In contrast to the current situation, in which commodity price increases are dampened by the existence of government-held stockpiles that may be released, a shift to privately held stockpiles would allow private holders of stocks to determine the path of commodity prices.

The dynamics of food price inflation would obviously change if this option were adopted. In the past, there has been pressure on the government to release its stocks of grain during shortages and thereby moderate food price inflation. Such pressure was balanced against interest in allowing

[6]Other analysts have suggested that the U.S. increase its food grain reserves only, e.g., raise the wheat reserve from 4 to 10 million tons as a device to protect food supplies. Such a step would provide some protection for low income countries which consume food grains as food but would give little protection to the United States, which tends to use feed grains for animal production. During the last major food crises in 1972/73, choices had to be made between allowing grain to be exported to prevent starvation or retained for animal production at home. The balance resulted in domestic food prices rising 20 percent between December 1972 and December 1973.

commodity prices to increase, so that growers could earn higher incomes. With stocks in private hands, food price inflation would no longer be the major criterion for determining when stocks are to be released. Private holders would place more emphasis on the economic gains to be achieved by holding stocks off the market until prices have risen. The limiting factor would become the availability of other countries' grain stocks, which could be shipped to the United States if domestic prices rose high enough to pay transportation and handling costs. In this context, it is worth noting that the terms of the Uruguay Round Agreements provide increased access to the U.S. grain market for foreign suppliers. More access will limit price hikes during periods of grain shortfalls and encourage release of stocks held by private firms. Essentially, the lowering of trade barriers increases the availability of supplies for all nations, and price fluctuations will be related to transportation costs as well as to domestic supply conditions.

Although the outcomes with and without government stockpiles might differ during grain shortages, the results during more normal years would generally be similar. Private stockpiling interests would evaluate supply-demand conditions and make judgments about the profitability of holding different levels of stockpiles. Sizable stocks would be held by exporting interests to ensure their ability to meet export contracts. Speculators would hold some stocks in anticipation of weather-related shortfalls in production. The level of speculative stocks would vary, with larger stocks held in the aftermath of a severe drought and lower stocks held after a series of favorable weather years.

As the stocks of other countries have grown, and as trade agreements have increased access to supplies from other countries, it appears more and more possible to extract the U.S. government from its current role in stockpiling programs. In closing, however, it should be indicated that doing so could have significant ramifications for U.S. foreign policy. In the event of a global shortfall, for instance, the United States might be faced with having to discourage exports to maintain price stability—which would raise concerns in foreign countries and in U.S. foreign policy circles. It is essential to balance this potential problem against the gains that would accrue from the elimination of government-held stockpiles to determine the best outcome for the nation.

POLICY OPTIONS FOR AGRICULTURE AND THE ENVIRONMENT

The U.S. public has developed a broader appreciation of agriculture's relationship to the environment since the 1970s. Agricultural production exerts detectable and, in many regions of the country, significant effects on the quality of water, wildlife, and soil resources (chapter 4). Although short-run trade projections do not indicate a large expansion in those effects, long-term production and world population growth will likely intensify pressure. At present, there are four major constraints inhibiting attempts to address agriculture's broader environmental agenda:

- environmental goals for agriculture remain unclear;
- inadequate science and monitoring hamper agroenvironmental priority setting and program design;
- many agroenvironmental programs do not adequately recognize the roles of private incentives and disincentives in program execution; and
- research and development to provide complementary technologies that link production and environmental goals have not been given priority, thus reducing options and flexibility.

These four constraints are all interrelated. Obviously, agriculture's environmental goals must be defined before programs to achieve those goals can be designed, and improved agroenvironmental science is crucial to identifying priority targets and implementing programs effectively. With clear program directions, improved science, and better functioning markets, however, public and private technology research and development can be mobilized to alleviate agroenvironmental problems more efficiently.

Establishing Environmental Goals for Agriculture

Despite six successive decades of federal involvement in conservation programs, the U.S. agricultural sector remains without comprehensive and consistent goals concerning water quality, soil quality, and wildlife resources (chapter 4). One such goal might be to eliminate agricultural water pollution that violates minimum drinking water standards by 2010. Related objectives could specify the nature of pollution reductions by given dates; for example, the control of fecal coliform bacteria and other pollutants from confined animal feeding operations by 2005.

Current environmental management efforts affecting agriculture emanate from at least 40 federal programs, begun at varying times to address specific issues (chapter 4). This plethora of programs reflects the incremental approach the federal government has taken to solving agriculture's environmental problems, which has resulted in fragmentation as well as possible confusion and conflict. A comprehensive evaluation of the many programs within USDA or in all federal agencies has not been undertaken to determine their consistency and overall efficacy.

The absence of consistent and comprehensive goals poses significant uncertainty and costs for farmers, ranchers, agribusiness, environment users, consumers, and government agencies. Pressures from long-term production and trade growth, coupled with increasing use of the rural environment, will likely exacerbate the situation. Placing U.S. agriculture on an economically and environmentally sustainable path requires comprehensive agroenvironmental goals, not only to guide current management efforts, but also to encourage public and private development and application of technologies that promote financial and environmental health.

Environmental goals for agriculture could be established in three ways. First, Congress could clarify the goals that are explicit or implicit in the 40 existing programs. This approach has not been taken for other industrial sectors perhaps because an industry-by-industry approach varies from overarching water, air, and other major legislation aimed at specific environmental resources or problems. Second, Congress could instruct an agency, such as USDA or the U.S. Environmental Protection Agency (EPA), to establish goals, drawing on input from industry, other federal agencies, state and local government, environmental interests, and other stakeholders. Again, there is little evidence to suggest such a top-down approach might be successful due to the combination of large deliberation costs and the industry not having a lead role in setting the goals.[7]

The third approach would vest responsibility for establishing goals in the private sector, with facilitation by government and input from other stakeholders. Of course, the private sector's environmental goals would be established under applicable government legislative requirements, such as the Safe Drinking Water Act's standards, to ensure the broader public interest. Preliminary evidence indicates that this private sector approach is feasible. The lndustries of the Future (IOF) program, which the U. S. Department of Energy (DOE) initiated in 1992, works with the country's seven most energy- and waste-intensive industries to establish future goals, including environmental improvement, thereby creating a future investment strategy (6). The Department's objective is to use industries' visions and goals to target its technology research and development assistance. Several sectors have established their goals or are in the process of doing so working cooperatively with the government agency. Complementing the IOF is EPA's Common Sense Initiative (CSI),

[7] In 1911, Congress charged USDA with defining long-term conservation objectives on private agricultural lands through the Soil and Water Resources Conservation Act, but the resulting National Conservation Plans (NCP) have not guided federal, state, or private activities. As evidence, the 1992 NCP did not receive congressional hearings, and the conservation objectives of the 1985 and 1990 farm legislation do not draw on the NCP goals or related discussions (13).

introduced in 1994. Through the Initiative, EPA works cooperatively with six pilot industries and all stakeholders to construct environmental plans that are to be applied industry by industry, rather than pollutant by pollutant (8). By design, a number of the Initiative's pilot industries are the same as those under the IOF program. Because the CSI has just gotten under way, it is not possible to evaluate its efficacy.

The IOF and CSI approaches capitalize on industry leadership and/or stakeholder input to create better opportunities for devising environmental programs that complement private incentives. It may be more difficult to establish private goals for agriculture, because of the large number of farm groups and other stakeholders, the many different kinds of production operations, and the expansive nature of environmental interactions. However, the private sector approach has the natural advantage of putting industry in a lead role to clarify its goals, thereby providing guidance for governmental program assistance.

ISSUE 1: *Strengthen agroenvironmental science and monitoring.*

Agriculture's relationships to water quality, soil quality, and wildlife health have not been comprehensively monitored or documented, despite numerous regional and local studies. The major obstacles to better knowledge have been relatively meager funding for environmental issues (about 10 percent of the federal agricultural research budget has been devoted to research on such subjects, compared with about 60 percent for productivity studies[8]), and the absence of an overarching federal agroenvironmental research agenda to promote targeted and coordinated agroenvironmental programs. Existing federal research programs have been described as lacking consistent goals and mechanisms to target key national priorities. Agroenvironmental research has become a bit more of a priority recently, but the efforts have been judged insufficient and untargeted by scientific associations. The upshot is that the current information base lacks comprehensive data on environmental conditions, the relationships between agricultural and environmental systems, and related biological health issues that are precise enough to guide policymaking, program implementation, and technological innovation (chapter 4).

Incomplete monitoring and science lead to two risks: the risk of acting too late or too narrowly to address environmental quality problems, and the risk of over regulation and lost competitiveness. Redirecting research to investigate the full range of environmental issues related to production, rather than almost exclusively pursuing higher yields, could lead to greater compatibility between agricultural practices and the environment. It is true that redirecting some funds away from improving production could cause concerns about food security. However, a shift in research toward complementarity rather than competitiveness between agricultural production and environmental quality could simultaneously address productivity and environmental goals. The two options presented here offer opportunities to achieve more complementarity.

OPTION A: *Congress could fund more federal research to strengthen knowledge of agroenvironmental systems, conditions, and implications.*

Three key agroenvironmental topics deserve more emphasis than they have been receiving: 1) the interaction of agricultural and environmental systems, 2) the geographic patterns of agroenvironmental conditions, and 3) their environmental health implications. Improved knowledge of these subjects would likely benefit the environ-

[8]It could be argued that productivity research contributes to enhanced environmental health by reducing stress on the land and water base to grow a given amount of food and fiber. However, this outcome has not been a major goal of the agricultural research programs and their fund allocations. Comprehensive evidence on the potential beneficial effects of productivity research in comparison to potential degradation is lacking.

ment as well as long-term industry competitiveness by allowing more precise program applications and minimizing unnecessary burdens.

Current agroenvironmental research institutions may neglect to examine key environmental questions needed for policy response, such as the cumulative and interactive effects of agrichemicals on biological health. The sophistication and cost-effectiveness of federal research at USDA, EPA, and the U.S. Department of the Interior could be enhanced by enacting a policy stipulating that all applied research funding decisions with agroenvironmental implications incorporate production, natural resource, and environmental factors. By implementing such a policy, government would recognize the need for a full accounting of significant environmental effects to supplement the market incentives driving productivity, thus encouraging complementary approaches. Such a policy also begins to lay the foundation for more effective program targeting and for developing innovative complementary technologies (chapter 4).

A research planning survey could examine the environmentally related data produced by all federal agencies to identify important "gaps," and reserve funds for a "gaps research portfolio." That portfolio could be guided, at least initially, by existing evaluations of agroenvironmental research, such as National Research Council (NRC) studies, and by expert panels. Innovative federal data collection groups such as the Federal Geographic Data Committee, the Consortium for International Earth Science Information Network, and EPA's Environmental Monitoring and Assessment Program could assist in such a gap analysis and portfolio design. Although data gaps and quality problems would not be eliminated by agency collaboration, these efforts could help improve overall data quality.

Additional incentives could be given to promote private-sector involvement in public research, such as granting limited patent protection or exclusive licenses for private-sector innovators. The research capabilities of agribusiness and environmental organizations could also be included in federal agency research efforts. However, private participation in agroenvironmental research may be limited by potential conflicts of interest between public and private goals, as well as the costs of collaboration. (The potential for public-private partnerships is discussed more fully in Issue 3, Option B.)

Without a clear federal commitment to improve agroenvironmental research and providing sufficient rewards to scientists, agency administrators can anticipate lost resources in endless coordination meetings. The chief potential drawback to redirecting research, however, may be agency resistance to the reallocation of existing authorization. Ultimately, bureaucratic incentives must be restructured to reward collaborative and coordinated research on priority issues. If, for technical or bureaucratic reasons, interagency coordination and collaboration prove impossible, Congress could assign full responsibility to one agency—for example, USDA or EPA. Without a strong commitment by Congress to redirecting agricultural research toward environmental topics, the criteria and standards by which departments will judge grant proposals will become bureaucratic hurdles rather than effective filters. If the research reallocation is implemented under the condition of no new funding, the shift of some production research funds to agroenvironmental research may meet institutional resistance. Therefore, development of a focused and well-documented research agenda is a prerequisite to such a research reallocation.

An initial research priority would be the establishment of a comprehensive set of minimum standards that ensure sustainable biological health. Some federal guidelines (standards) have already been established, particularly for drinking water quality (chapter 4, appendix 1), but these guidelines mostly concern human health and may not address all potential environmental problems. As a first step, more complete water quality standards can be devised. Water quality may be the best single indicator of agriculture's role in environmental conditions affecting biological health. The quality of surface and ground waters directly affect drinking water, aquatic habitat, and recreational uses such as swimming, boating, and fishing. The quality of surface water defines the vi-

ability of much terrestrial habitat and is closely related to soil quality; water is perhaps the most important factor in the transport of pollutants through waterways or through atmospheric cycles.

Developing biological health guidelines is likely to be resource-intensive, although much of the cost could be redirected from existing federal agricultural research. Coordinating and streamlining research initiatives would be achieved by redirecting rather than augmenting existing budget authorization. Budget redirection of this kind would clarify the federal goals and provide for more strategic management of existing research and program funds. Given the difficulty of the task, a periodic congressional oversight schedule would help ensure that standards were devised in a timely fashion.

OPTION B: ***Congress could direct that improved science be used to target high-priority agroenvironmental problems.***

Since the mid-1980s, federal conservation and environmental programs relating to agriculture have been increasingly focused on particular problems and geographic areas. Unfortunately, weak and incomplete agroenvironmental science hampers the potential of targeting. As noted above, increased understanding of the interlinking of agricultural and environmental systems, geographic conditions, and biological health implications would aid targeting.

Until these weaknesses are remedied, opportunities for improved targeting exist with available information. The most elaborate targeting protocol emerged from congressional instructions in the 1990 farm legislation to improve the environmental cost-effectiveness of CRP enrollments. Three steps were taken: the list of eligible lands was enlarged to include special water quality areas, a rental bid cap was established so that CRP payments could not be more than the market rate, and parcels were ranked by a calculated environmental benefit index. Analyses of the results suggests that the targeting process did improve environmental benefits per dollar of CRP expenditure. Nonetheless, further improvements are possible, including the addition of other environmental dimensions such as wildlife. Applying this kind of targeting process to other agroenvironmental programs for water and soil quality, wetlands protection and wildlife habitat holds the potential to improve cost-effectiveness.

To further improve targeting efficacy in the face of incomplete science, Congress could assemble a group of leading scientific experts to assist in identifying priority areas. Box 7-1 describes an exercise that OTA conducted to investigate the feasibility of improved national targeting using expert scientific judgment. The process proved to be low cost and resulted in certain geographical targets serving multiple subjects such as water quality, soil quality, and rangeland health and wildlife. The expert panel could be a first national step toward identifying priorities, followed by further refinement of priorities at the state or local levels, where knowledge of environmental details is greatest. Targeting within even a single watershed can improve program efficacy.

Targeting would involve costs for information collection and analysis. Public investments in research and technology can reduce those information costs. Targeting program efforts to high-priority areas may also involve higher program costs to make changes in land and water use, as evidenced by the increased rental payments for targeted CRP enrollments after 1990. However, the higher program benefits may still exceed costs. Finally, the reallocation of agroenvironmental program assistance will likely induce political resistance from those benefiting from the current distribution.

ISSUE 2: ***Strategically target agroenvironmental programs based on private incentives.***

Evaluations indicate that strategic improvements in the way agroenvironmental program approaches are employed would provide more enduring and cost-effective solutions (chapter 4). In general, they have not been targeted enough to the situations where the program complements private incentives or offsets private disincentives.

BOX 7-1: Using an Expert Panel for Environmental Targeting

OTA convened a group of leading scientists to examine 10 major environmental subjects related to agriculture: soil quality, surface water quality, groundwater quality, water conservation, wetlands, rangelands, rural landscapes, plant diversity, insect diversity, and wildlife. The principal purpose of the exercise was to determine whether it was possible to identify geographical priorities for each subject. Each panelist had a simple but challenging task: draw up a list of the 10 areas in the country that should receive targeted program attention for his or her subject The physical size of the geographic area was not restricted, but panelists were asked to be as precise (and keep their areas as small) as possible. (Large areas inherently diminish targeting efficiency, unless the environmental or conservation problem in question applies in equal measure throughout the area) A geographical information systems expert facilitated the targeting experiment.

The exercise resembled a Delphi process of soliciting expert judgment, then sharing it with other panel members and OTA staff, and then feeding it back to the panelists for possible revision. Each panelist was asked to consider environmental, economic, and social criteria in making his or her choices, but was not required to adhere to a fixed procedure. A major project goal was to extract as much expert judgment as possible from the panel members without imposing constraints on them, thus encouraging innovative approaches. (A potential disadvantage of this method is that the panelists, each using different criteria, weights, and standards, might come up with inconsistent results. However, imposing a standard protocol would either make the exercise impossible or create other unknown problems given incomplete science.) Each panelist was encouraged to consult with peers around the country to put together the best database. A majority of panelists contacted from five to 30 peers to incorporate their views. Thus, the panel's priorities reflect a broad range of professional input.

Five overall findings emerged from the exercise:

- It is possible to identify general geographic areas/regions that need special program attention--that is, it is possible to set priorities--by using existing data augmented by expert scientific judgment
- The national selection of priorities yields approximate boundaries and should be augmented by a companion state and local process to identify the most pressing problem areas and farms within the priority regions, using the best scientific expertise in those areas
- The geographical priorities for several conservation and environmental subjects overlap considerably, suggesting that the potential for program complementarily exists.
- In the process of selecting priorities, weaknesses in science and data are quickly apparent These weaknesses can help define the research and data collection agendas to aid conservation and environmental monitoring and problem remediation.
- The databases on several subjects, most notably plant and insect biodiversity, are not adequate to define even approximate geographic priority areas with confidence. However, keeping these subject areas in the priority-setting process is essential to covering the whole agroenvironmental system

OTA is continuing to refine the expert panel approach to environmental targeting, with a special focus on identifying environmentally sensitive lands of national importance.

SOURCE: Office of Technology Assessment, 1995.

Voluntary education and technical assistance programs, which can work well in certain circumstances and do not incur high net costs for agriculture, have not produced significant and wide-ranging environmental results. Subsidy-based programs could be better targeted to priority areas and to implementing cost-effective technologies. As matters stand, some regulations affecting agriculture's environmental performance could be implemented in simpler and less costly

ways. Two options that complement one another could potentially redress some of the current programs' shortcomings.

OPTION A: ***Congress could put existing programs into three basic approaches.***

Key to structuring more effective federal programs is identifying the strength of private incentives to implement environmental practices (chapter 4). The multiple existing programs may be categorized into three major approaches based upon the nature of those private incentives:

- When farmers have incentives to adopt technologies that increase profit and simultaneously improve environmental conditions (the "win-win" case), voluntary education and technical assistance can accelerate and expand adoption.
- For situations in which farmers have insufficient incentive to adopt technologies that provide environmental benefits to other parties, voluntary compensatory (subsidy) programs may be necessary.
- When farmers have inadequate incentives to discontinue damaging practices that violate minimum environmental standards, regulation may be necessary.

Employing this categorization offers the potential to diagnose which program is most suitable in responding to specific targets or targets where private incentives are similar. Streamlining programs in this manner can minimize overlap and conflict. It could also help evaluate program performance more systematically. For example, all problems requiring compensation to offset farmer disincentives can be put under one category to compare their relative benefit and budget consequences as a group.

Regardless of the mix of agroenvironmental programs adopted, all measures could be implemented under the guidance of a whole natural resource management farm plan. Such a plan incorporates soil quality, water quality, and wildlife habitat into the farm's production system on an integrated basis, rather than treating them as separate components. Requiring development of the plan by the farmer with expert private and public assistance, captures the operator's intimate knowledge of the farm's natural resources. That knowledge is essential to best design management systems that achieve agriculture's environmental goals while simultaneously achieving profit and production objectives.

In structuring more effective federal programs, it is also important to delegate authority and responsibility to the governmental levels at which programs can be operated most cost-effectively. Federal leadership and oversight will be needed to achieve national environmental goals that apply uniformly across the country, such as decreasing pollutants in air or water that cross state or national borders. However, state and local governments likely have the best information in their areas on environmental benefits and incentives to reduce compliance costs in achieving national goals.

Education and Technical Assistance

As noted above, voluntary education and technical assistance programs will likely be cost effective when it comes to new technologies that offer net benefits to farmers and to the public. Such technologies as soil nutrient testing and conservation tillage, for instance, often reduce production costs as well as improve soil or water quality. Adoption of similarly beneficial technologies may be hampered, however, by lack of information, fear of the risks involved in change, insufficient financing, the need for new management skills, or conflicts with other public programs. In these cases, education and technical support, perhaps supplemented by temporary cost-sharing, may help farmers overcome their reluctance. The public environmental benefits accruing from use of the new technologies would likely be ongoing, as private interest in continuing to use the new technologies ought to be high. The costs of each educational and/or technical assistance program would depend upon the program's scope but probably would not be significant, because the infrastructure for these programs already exists.

Existing government and university education and technical assistance efforts, such as the Natu-

ral Resources Conservation Service's Conservation Technical Assistance Program and the Extension Service's outreach programs, could be focused on these opportunities. The process of constructing a whole farm natural resource plan will likely identify such education and technical assistance needs. In general, more systematic effort needs to be given to identifying the environmental problems and potential technological solutions that offer "win-win" outcomes than past program efforts. As chapter 4 revealed, there is a lack of evidence to indicate past federal education and technical assistance programs have caused significant conservation gains implying they have not been targeted predominantly to those "win-win" situations.

Compensation (Subsidies) for Environmental Services

Discussion in chapter 4 indicated that subsidy-based programs have not been well targeted. The compensatory approach should be reserved for those priority situations where the public desires performance beyond minimum environmental standards and farmers do not have natural economic incentives to achieve the desired levels. Vermont's nonpoint water pollution control program rewards farmers in this manner after they have fulfilled minimum practice requirements.[9] At the national level, the present ambiguity about environmental goals relating to agriculture means that minimum standards are determined program by program rather than for all subsidy programs as a group.

A critical first step in improving subsidy program performance is to employ the geographical targeting protocol described in Issue 1, Option B. Where federal funds are being used, the national identification of priorities is necessary to ensure national goals are served. State and local authorities can further refine the targets after the selection of national priority areas.

The next step is to identify cost-effective practices for the environmental situation. Subsidies should finance contracts or practices that provide the broadest and most enduring environmental benefits per tax dollar spent as a matter of principle.[10] For example, if the environmental problem requires long-term protection, such as the restoration of migratory wildlife habitat to allow population recovery, then securing a long-term practice avoids the administrative cost and possible environmental disruption of renegotiating short-term arrangements. The long-term arrangement may even cost more per year but still yield greater net benefits. Also, as a rule, flexibility should be given to farmers to design and implement innovative practices that are sensitive to local conditions but satisfy national environmental performance standards. Finally, in situations that provide incentives for both the federal government and the states to undertake such programs, a matching block grant program could be used.

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[9]To improve state water quality, Vermont has established a two-tiered system of approved agricultural practices (AAP's) and best management practices (BMP's) that, when signed into law in 1995, will apply to all Vermont farmers (9). AAP's define categories of practices that all farmers must follow to prevent nonpoint source water pollution from agriculture; the practices relate to discharges, nutrient and pesticide storage/applications, soil cultivation, waste management, buffer zones next to streams and rivers, and structures. BMP's are anticipated to further enhance environmental benefits but adopting them is voluntary. Because BMP's confer environmental benefits in excess of their AAP responsibilities, farmers who adopt them are entitled to public payment.

[10]Programs such as this would have to be designed to avoid conflicts with Uruguay Round Agreements (URA) restrictions on agroenvironmental subsidies. The URA added three requirements to subsidy (green) payment program design: 1) payments must be part of a clearly defined government program, 2) the subsidies must have no or minimal trade-distorting effects, and 3) payments must be limited to added cost or lost income from the practice or technology shifts (chapter 5).

Regulation for Minimum Environmental Standards

If agricultural practices that do not meet minimum environmental standards cause significant public risks or costs, regulation may be the only answer. Farmers do not typically have economic incentives to change production practices that cause damages off their farm, except if they are threatened with public program sanctions or private lawsuits. Pesticides migrating to drinking waters, as well as nutrient and fecal coliform pollution from confined animal facilities, are among the agroenvironmental problems traditionally handled through regulation. Regulations are feasible only when the pollutant or desired practice can be measured and monitored for enforcement. Because agriculture has many nonpoint pollution problems diffusely spread across the land that are difficult or impossible to measure, monitor, and enforce, environmental regulation may apply to practices or quality conditions.

For regulations that apply uniformly across the nation, such as pesticide registration, or that apply to pollution flows crossing state and national borders, federal action can ensure equitable treatment over states to fulfill national responsibilities. However, in many cases, such as water quality programs, it is more technically feasible, and more efficient, to delegate implementation to state and local governments. The minimum environmental standards may have to vary by state or even within the state, according to the regional nature of environmental resources, production technologies, and public demands. In one of the first applications, Vermont has recently proposed a set of accepted agricultural practice rules applying to all farms. Where nonpoint sources dominate, monitoring regulatory compliance will likely depend on evaluating implementation of whole farm natural resource plans.

The budget cost of using regulations for minimum environmental standards is not clear. If some regulatory approaches for minimum standards replace existing subsidy programs, federal budget savings may accrue, depending on the added administrative expense of designing, monitoring, and enforcing the regulations. Costs to the private sector—for purchasing equipment to meet regulations, perhaps, or for paying noncompliance penalties—may increase. But the amount depends on the level of the standard and the regulatory mechanism used. Some alternatives to traditional regulation, which often requires farmers to choose from a list of acceptable practices, hold the potential to lower those costs. Capitalizing on the knowledge and incentives held by farmers offers ways to reduce regulatory rigidity and cost. Pollution permits may be traded among farmers to meet an overall pollution reduction goal, as air pollution rights are now traded. For example, a tradable permits program for water quality in the grasslands region of California's Central Valley could save 20 percent compared with traditional best management practices (12).

Another alternative to traditional regulation would be to exempt farmers from citizens' lawsuits and the multiple (sometimes conflicting) regulatory requirements of different agencies if they are actively implementing approved whole farm natural resource management plans for their farms. The plan would be approved by the state or federal agency responsible for implementing the regulation. The efficacy of this "regulatory exemption" approach hinges on two factors: the strength of farmers' incentives to reduce regulatory burden, avoid lawsuits, and clarify uncertain compliance status; and the costs of implementing the management plan. Public statements by farm groups suggests that the incentives may be significant for many farmers.

The costs of meeting the management plan requirements depend on the level of public environmental standards and the flexibility given the farmer in meeting the requirements. Given minimum environmental standards, the development of the detailed plan could be vested with the farmers—an approach that could promote flexible, innovative approaches. Federal and state government resources would be used primarily for education about goals and standards, as well as for monitoring and enforcement. Private-sector agroenvironmental consultants would likely respond to the planning demands by farmers and

provide technical assistance. The major challenge of this approach is defining exactly what a farmer must do to be exempted from suits brought under environmental regulation and regulatory penalties. An implicit benefit of the approach is to reward farmers who have taken steps to improve the environment, rather than paying farmers to stop harming it (as past programs have).

OPTION B: ***Congress could facilitate private market approaches.***

Clearer definitions of public agroenvironmental goals, minimum quality standards for farmers, and private incentives for adopting environmentally preferred technologies or practices may facilitate market resolution of some agroenvironmental conflicts. In effect, this approach pursues private compensation for environmental services. These market approaches are not well-suited to large issues involving many diverse parties or to emergency situations. The purchase of nature preserves by nonprofit conservation organizations is a relevant example, as is the sale of recreation privileges on private farmland for hunting or other purposes. Also, clarifying the assignment of legal liability for environmental damages under common law may help resolve some local environmental disputes by private parties through the courts.

Legislative action can encourage the development of market approaches to enhance agroenvironmental management. Standardizing consumer labeling on product or process standards on agricultural products is a relevant example. Market research shows that consumers increasingly prefer purchasing food, fiber, or other products that contribute to human health and environmental quality. This trend suggests that federal involvement in standardizing labeling could be a cost-effective way of leveraging significant private sector incentives toward production and environmental complementarity within the market place. Consumer information, primarily through product labeling and reliable certification of process standards, is critical to allowing consumers to convey market preferences. Standards for organic farm products are a relevant example. Consumer demand for organic food products has shown sustained, high growth for several years.

Unlike nutritional labeling, environmental labeling remains optional, in some cases, controversial, and generally unsystematic. Process certification standards, like organic food labeling, vary from state to state and depend on the requirements of different certifying organizations. Such disorganization makes consumer choices more difficult and reduces consumer confidence in the validity of market information. The 1990 farm bill requested definitions of organic food standards, but progress has been slow.

Industry trends toward vertical coordination may tie the retail and production sectors closer together, so processors can better influence product quality and environmental side effects. Food manufacturers are increasingly negotiating contracts with producers that specify agroenvironmental practices to enhance marketing appeal (chapter 2). The federal government could play an essential role in this process by ensuring that markets can be formed and operated easily across state and country boundaries. Congressional action on these issues may also avoid the possibility of other countries restricting imports of agricultural-related products due to uncertain human and environmental health status.

ISSUE 3: ***Accelerate agroenvironmental technology research and development.***

The pursuit of complementarity between agricultural production and environmental quality objectives has not been emphasized in the United States. Although other countries also appear to have neglected such initiatives (1), the United States may be missing out on benefits of competitiveness and technology export expansion, as well as improved domestic environmental quality, by failing to stress complementary technologies for agriculture.

If production technologies can be developed that manage pollution or otherwise protect ecosystems within sustainable limits and maintain profit, they make sense from private economic,

environmental health, and taxpayer perspectives. If certain technologies are widely used, they can have a significant and positive environmental impact—most notably on water and soil quality and wildlife habitat.[11] Conservation tillage, soil nutrient management, and "precision farming" are some of the most common examples cited. However, the potential of these technologies to fully capture complementary production and environmental objectives has not been assessed. The prospects for a single technological "silver bullet" are, of course, remote. More likely, a range of such technologies must be tailored to different kinds of farms and environments. Even so, it is not clear that all environmental problems can be solved in a cost-effective manner with complementary technologies. Nevertheless, the evidence indicates that they have broad potential in the United States (chapter 4).

The dominant agricultural technologies of today generally promote output efficiency, to ensure an inexpensive and abundant food supply. However, technologies oriented primarily to increasing output may have larger costs associated with them than anticipated—even in the course of normal use, some may cause excessive environmental degradation (chapter 4). Despite a well-established research and extension system, the present agricultural technology research and development agenda may not be keeping pace with changing needs of farmers, consumers, and those who use rural environment resources for recreation or other uses. Maintaining the present technology research and development strategy could ensure low-cost food supplies in the short term, and perhaps in the long term. But the toll on environmental health will likely increase. Two related options aimed at avoiding such a predicament, and at promoting complementary technology, are examined below.

OPTION A: ***Congress could make complementary technologies the centerpiece of federal agricultural research, development, and assistance.***

Congress could take a preliminary step toward promoting complementary technologies by commissioning a review and evaluation of existing agroenvironmental technology developments. Such a review would assess the prospects for improving environmental quality and agricultural productivity simultaneously in the public and private sectors. Based on such an evaluation, Congress, together with USDA, could identify the most strategic federal role in stimulating and disseminating complementary technologies.

The second step would be to redirect USDA research along the lines described in Issue 1, Option A. Congress could oversee the shift toward mutual reinforcement among efforts to promote nonchemical pest control, sustainable agriculture, water quality improvement, soil quality improvement, wildlife conservation, and productivity improvement. Potential conflicts between a complementarity focus and commodity program incentives may require legislative action.

Obstacles to refocusing USDA's research and development programs in this way may be organizational and philosophical. In its review of USDA's sustainable agriculture programs, for example, GAO found that coordinating the activities of these programs was very difficult. Coordination was a striking challenge among agencies that were under the jurisdictions of different assistant secretaries.[12] Although USDA has recently undergone a reorganization, communication prob-

[11]Foreign market opportunities for these technologies may exist as well, although the technologies require natural resource and production specific contexts.

[12]A senior USDA manager involved in directing the water quality initiative said he did not believe that water quality and sustainable agriculture goals are the same: water quality focuses on technological changes to protect groundwater, such as satellites and lasers to analyze soil; whereas sustainable agriculture focuses on biological and management changes, such as crop rotations. In contrast, a senior sustainable agriculture program official believed water quality protection and the technology development are part of the scope of sustainability (4).

lems among research, conservation, and other programs may still exist.

OPTION B: ***Congress could facilitate public private partnerships to develop complementary technologies for agriculture.***

A strategy to leverage private research and development of complementary technology with directed public funds could be both feasible and productive, especially given budget constraints. Federal/private partnerships aimed at developing complementary technologies could be better focused and significantly expanded at the national and regional levels. Such collaborations could spur a broad spectrum of private innovation dedicated to the dual objectives of making profits and promoting environmentally sound production technologies. Research and development funds could be directed specifically toward enabling producers to meet minimum environmental quality standards, for example, as outlined under Issue 2, Option A above.

In plans for its IOF partnership program, DOE characterized the goals of the new partnerships in a statement that could well apply to public/private partnerships for complementary technologies for agriculture:

> Initially spurred by a command and control mindset, industry and government have been moving rapidly toward a more sophisticated perspective that embraces pollution prevention, efficient resource use, and renewable energy. The reasons for this shift are simple: advanced, integrated process technology can simultaneously improve the efficiency of energy and resource use, improve the quality of products, and reduce waste while reducing costs and enhancing competitiveness. Such technology . . . benefits the industry, the environment, and the nation (6).

Congress could enable the partnerships to develop a range of complementary technologies, including crop rotations, diversified farming systems, biological controls for pest management, genetic engineering of crops with attributes of drought and other climatic tolerances, and computer-assisted decisionmaking systems. Such a range of technologies would be essential for an industry characterized by many different types of farming and environmental systems (chapters 2 and 4). Further, federal involvement would ensure a greater emphasis on public environmental benefits in the creation of such new technologies. In the past, applications of research into privately patented technology have generally not been constrained to provide direct public benefits, such as improved environmental quality, and so potential returns on the public investment have been lost. That would change if the options to emphasize agroenvironmental performance and complementary technologies are adopted.

Corporate partnerships will likely focus their efforts on applied research that can lead to profit-making commercial applications. Some technologies that hold significant profit potential may not require public partnership at all. ("Precision farming" may be such a case.) However, it is unlikely that the full potential to enhance public environmental performance will be captured in those cases. Some complementary technologies may not have much potential to boost corporate profits. Special public efforts may therefore be required to encourage the development of such technologies. A particularly effective model for research and development may be the federally funded Sustainable Agriculture Research and Education (SARE) program, which encourages collaborative problem solving by leveraging private innovation with public funds.

POLICY OPTIONS FOR AGRICULTURAL TRADE AND THE ENVIRONMENT

As international agricultural exports and imports grow, the environmental repercussions associated with trade and production change accordingly (chapter 5). The environmental effects of expanding domestic agricultural production to meet foreign demand during the next decade will be small overall. Some localized areas where the effects of trade are felt most, such as border zones, may be significantly affected.

The amount of environmental damage or improvement resulting from trade expansion depends principally on how effective management programs are, not on the volume of trade in question. Present programs for managing the environmental side effects of production suffer shortcomings (chapter 4). If improved through cost-effective monitoring, targeting, decentralized management, and technology development, as discussed above, the programs could cope with any significant environmental problems related to trade. They would be unlikely to have a negative influence on competitiveness or encourage agricultural producers to migrate overseas. Rather, trade will be affected primarily by the possible improper application of future environmental controls as nontariff barriers to international agricultural commerce.

The policy challenges in this arena are to ensure that management programs address the special environmental concerns related to agricultural trade--even those that transcend domestic borders and trade-related institutions. One well-publicized concern is the inadvertent importation of harmful nonindigenous species; another is how to develop trade-related institutions for coping with transboundary and global environmental problems related to expanding international agricultural commerce. A third is how to develop institutions, apart from trade organizations, to better manage global environmental resources of interest to the United States and susceptible to pressure from expanding agricultural trade. A final consideration is how to exploit opportunities for expanding environmental technology trade to assist other countries in managing agroenvironmental risks that may affect U.S. interests.

ISSUE 1: *Control invasions of harmful nonindigenous species.*

Chapter 5 described how expanded international commerce opens new pathways for importation, intentional and accidental, of foreign species. Although many of the foreign species introduced (such as new plant varieties) will benefit the agricultural sector, a number will cause harm, if past events are an indicator. A partial accounting of past damages from selected previous invasions of harmful nonindigenous species (HNIS) totals about $100 billion (a figure that does not fully incorporate economic or environmental losses). Future losses from a limited number of significant cases may well exceed that figure. Both cost estimates are conservative. Many of the commercial damages are concentrated in the agricultural sector and its related natural environment.

The growing problem of nonindigenous weeds has particular relevance for agriculture. The OTA assessment reviewed in chapter 5 proposed four separate options for improving the patchwork of incomplete programs controlling their entry and spread:

> **Option:** Congress could amend and expand the Federal Noxious Weed Act to rectify several widely acknowledged problems regarding definitions, interpretations, and its relationship to the Federal Seed Act . . .
>
> **Option:** Congress could require that all entities introducing nonindigenous plant material conduct pre-release evaluations of its potential for invasiveness . . .
>
> **Option:** Congress could require that the Animal and Plant Health Inspection Service (APHIS) conduct periodic evaluations of its port and seed inspection systems to test their adequacy and provide feedback for improvements . . .
>
> **Option:** Congress could monitor and evaluate closely the weed control efforts undertaken by federal agencies as a result of the Federal Noxious Weed Act amendments in the 1990 Farm Bill (5).

As concerns about pesticide safety may reduce the range of control measures, changes in the Federal Noxious Weed Act and weed management on federal lands have particular importance for agriculture. Other aspects of the options are being addressed: APHIS, for instance, is developing performance standards for port inspection. More may be taken up in the farm bill deliberations.

Several general issues related to HNIS also relate to expanded agricultural trade and the envi-

ronment. First, a comprehensive HNIS monitoring system does not exist, which means that changes in the rate or composition of invasive and detrimental species cannot be assessed. Second, there are insufficient criteria and standards to evaluate the invasive character of new species that affect agricultural production and related environmental resources. Finally, agricultural trade may be a source of HNIS that will affect the environmental health of fish, wildlife, and other natural areas. Options for addressing these problem areas include measures for improved border control and screening, control and eradication programs for natural areas (for example, parks), enhanced environmental education for prevention, better emergency responses, improved funding and accountability mechanisms, and provisions for reviewing and regulating biological control organisms.

Three types of benefits could result from low-cost improvements in targeted control, without restricting the exchange of helpful species or other trade. First, agricultural production losses from HNIS such as weeds would decline. Second, damages to protected natural areas would diminish. Finally, effective multilateral guidelines for trade involving foreign species could prevent other countries from restricting U.S. agricultural exports through misapplied health and safety regulations. Additional public resources would be needed to implement most of the options. Agricultural trade flows should not be unnecessarily restricted if control programs successfully target HNIS without negatively affecting the introduction of helpful foreign species.

ISSUE 2: *Improve trade-related institutions for managing agricultural trade and environmental effects.*

Some of the most challenging environmental problems related to trade are transnational in nature. If one country increases its agricultural production, for example, lakes and rivers that it shares with other countries may become more polluted, and rare or endangered species that fly, swim, or walk across borders may be destroyed. Multilateral institutions geared toward addressing these problems (while ensuring that unnecessary restrictions are not imposed on trade) are now emerging. But because they are so new, there is little evidence with which to gauge their effectiveness. The two courses of action described below are intended to ensure the full and timely implementation of their agendas.

OPTION A: *Ensure oversight of the North American Agreement on Environmental Cooperation's (NAAEC) provisions related to agriculture.*

Congress could provide timely oversight of NAAEC implementation, a landmark achievement in linking a regional environmental management agreement with a trade pact. There is little experience to draw on in anticipating the nature of progress and problems with NAAEC. It appears that some new U.S.-Mexico initiatives are under way, but significant obstacles may exist or emerge to prevent them from in achieving their full potential. The administration is responsible for collecting information on the North American Free Trade Agreement (NAFTA) and NAAEC, and could brief Congress so that it can actively treat emerging problems. The NAFTA/NAAEC implementing legislation requires periodic reporting, and this option reinforces timely reporting. A periodic oversight schedule seems prudent and a low-cost first step.

An integral part of the reporting should be assessments by the United States, Canada, and Mexico of agroenvironmental problems related to trade and progress in managing those problems. Under the agreement, the North American Commission on Environmental Cooperation must review progress and problems under the agreement, and make its assessments open to the public. Little expense should be incurred in presenting those findings to Congress on a timely, regular basis. Another part of the NAFTA/NAAEC oversight could be a review of environmental regulations that are not scientifically justifiable and serve as nontariff barriers to agricultural trade. Building a public database to accurately describe and monitor these developments would aid both govern-

mental and private-sector efforts to minimize unnecessary obstacles while promoting legitimate environmental management.

OPTION B: ***Review the progress of the World Trade Organization (WTO) on resolving agroenvironmental issues related to trade, such as trade in genetically engineered organisms and organic farm products.***

Along with NAFTA, the Uruguay Round Agreements (URA) open the door to expanded U.S. agricultural trade with the world by lowering trade barriers and reducing export subsidies. If history is any guide, however, the food safety and environmental regulations of each member country may increasingly be used as nontariff barriers to trade. The URA established new rules on sanitary and phytosanitary (SPS) measures to protect human, animal, or plant life or health from the risks of spreading pests and diseases, and from additives or contaminants found in food, beverages, or feedstuffs. The new agreement requires that agricultural product standards be based on the best available science, sets some minimum international standards, requires risk assessment, and employs a least trade-restrictiveness test, among other provisions. A new Technical Barriers to Trade (TBT) code also establishes a standard international protocol for distinguishing legitimate uses of product standards for food labeling, packaging, composition, and other functions.

The SPS measures directly and indirectly touch on some agroenvironmental issues, such as HNIS and pesticide use and residues. However, the outcomes of SPS disputes related to environmental issues must await future WTO case rulings. There are concerns that the TBT code, in contrast to NAFTA rules, gives too much discretion to dispute panels on environmental matters (10). Apart from dispute panels, other WTO mechanisms to handle environmental matters include the Article XX (g) provision relating to conservation of natural resources, but much uncertainty also exists about their potential applicability. It may be more difficult for Congress to review the activities of the WTO's Trade and Environment Committee than to review the activities of NAAEC, because the committee's operations are not as open as those of NAAEC. However, the Office of the United States Trade Representative (USTR) is participating in the Committee's activities along with other WTO members, and should be able to keep abreast of progress and emerging problems.

The development of processes, criteria, and standards related to agricultural production technologies and products are all important agroenvironmental issues. A key concern of late has been the proper application of product-related and process standards to trade in genetically engineered plants and animals, as well as trade in organic farm products. Early scientific and policy attention to such concerns could reduce the possibility of unnecessary trade restrictions and significant environmental risks. Other process and production method (PPM) issues related to agriculture—for which there are no clear guidelines and rules—may arise. There are currently, for example, proposals to develop guidelines for rewarding WTO countries that keep their trade regimes open while they address emerging transboundary and global environmental issues related to PPMs (11). Generally, a wide array of environmental trade measures could be advanced, each with very different legal, trade, and environmental implications. The expense of careful congressional review of these and other developments is low, given the potential for keeping agricultural trade open and addressing agroenvironmental problems worldwide.

ISSUE 3: ***Develop international institutions outside trade organizations to manage transboundary environmental issues related to agriculture.***

Many transboundary and global environmental phenomena either transcend trade or are better handled through forms of multilateral cooperation other than trade agreements. The Montreal Protocol on reducing ozone-depleting substances and the Rio Conventions on climate change and biodiversity are examples of such multilateral cooperation. Although there are more than 1,000 international environmental agreements, their

overall effectiveness has not been assessed (chapter 5). The small number (about 20) that use trade measures appear to be effective. It is important to note, however, that existing multilateral environmental institutions do not have sufficient authority and resources to resolve complicated international environmental problems (2).

Addressing these transboundary and global issues will take time because the links between the environment and agricultural trade are poorly understood, management institutions are immature, and multilateral negotiation and collaboration are slow, costly processes. Immediate attention should be given to structuring productive agreements and institutions that help the United States avoid large environmental risks and keep international agricultural trade as unrestricted as possible. The two options delineated below build on each other to address the issue.

OPTION A: ***Congress could review international environmental management agreements affecting agriculture.***

Past efforts to address environmental problems beyond U.S. borders have generally been made on a case-by-case basis, as the negotiation and signing of the Convention on Trade in Endangered Species (CITES), NAAEC, and the Montreal Protocol demonstrate. This approach conserves negotiation, implementation, and enforcement resources, which are, as matters stand, expended only on problems that achieve international notoriety. So far, such agreements have not restricted trade in any major way. Nonetheless, this case-by-case approach is often reactive rather than proactive, especially with regard to management issues that hold potential for large-scale and irreversible environmental change. There are a few multilateral funding institutions that address international environmental problems—such as the Global Environmental Facility (GEF) of the World Bank, United Nations Development Program, and the United Nation's Environment Program—but at this writing they suffer from a lack of resources. The GEF fund, for instance, depends on voluntary contributions and appears to be far too small to contend effectively with the welter of global environmental problems it faces.

One agricultural trade problem that has resulted, in part from the implementation of international environmental agreements (and has been hotly debated in recent years) concerns methyl bromide. Widely used as a soil fumigant in producing certain crops, and for treating agricultural exports and imports, methyl bromide also depletes ozone and is targeted for reduction under the Montreal Protocol. EPA, under authority of the Clean Air Act, is planning to phase in a total ban on methyl bromide use in the United States by 2001. Estimates show that a reduction or ban would yield benefits far in excess of costs (7). But countries that are not taking such a stringent approach, or have not signed the Montreal Protocol, may consequently enjoy a competitive advantage in the international agricultural marketplace. Preliminary estimates indicate the ban would cause short-term annual losses of about $1.2 billion to agricultural producers and consumers, assuming that there are no new chemical substitutes for methyl bromide. A congressional review of possible federal actions that might help the U.S. agricultural sector adjust to the methyl bromide phaseout, such as technology research and development, would be extremely useful.

OPTION B: ***Examine the feasibility of a global management institution to treat adverse environmental consequences of agricultural trade expansion.***

Congress could initiate multilateral discussions on the adequacy of current institutions to address transboundary and global environmental problems that significantly affect U.S. interests. Commentators have suggested alternative approaches and institutions with different implications for U.S. involvement (2,3,11). A global environmental organization that would incorporate existing piecemeal programs could work with the WTO to ensure that economic and environmental agendas do not clash. As evolving science reveals new links among transnational environmental systems, and as nations' economies become in-

creasingly globalized and interdependent, the benefits of comprehensively investigating linkages seem apparent. As with other policy options advanced in this section, the expense of the preliminary investigation would be minimal in comparison with the potential benefits.

Issues related to agricultural production, which has an impact on so much water and land around the globe, would be one element of the review. Many analysts believe, for example, that the greatest environmental challenges from liberalizing and expanding agricultural trade will occur in developing countries that have immature environmental management institutions. The proposed review could address this concern by coming up with a blueprint for precautionary management assistance to these countries. Another important function of the review could be to develop an information base that would help scientists and policymakers to anticipate the nature of likely environmental problems and possible research responses.

ISSUE 4: *Foster private and public agroenvironmental technology transfer.*

Because the United States has developed considerable environmental management experience from almost three decades of programs, its industries have developed the capacity to competitively produce and export technology abroad. Environmental technology is in fact now a U.S. export growth industry, and it may serve national interests well by providing foreign countries with the training and technology to treat global/transboundary environmental problems that may eventually affect the United States. (New technologies for applying pesticides to minimize harm to nontarget wildlife species that migrate to U.S. territory are an example.) There is no major role for the federal government to play in promoting this market-based approach to remedy environmental problems. The government could, however, assemble information and conduct analyses to ensure market access for U.S. firms and to appraise targeted public research assistance.

Little is known about the applicability of environmental technology exports related to agriculture. As explained in chapter 4, environmental management in agriculture has not (unlike other industries) been highly regulated. As a result, the sectors supplying agroenvironmental technologies to domestic industry have been motivated mostly by subsidies rather than regulation. It is not clear if the dominant voluntary subsidy approach has yielded a competitive advantage in international environmental technology markets. Some new complementary production-environmental technologies, such as information-based nutrient management, could apparently be used in foreign settings.

The potential benefits of assisting other countries in dealing with environmental management problems that result from expanding agricultural production may warrant attention from the public and private sectors. The public interest is in managing transboundary or global environmental resources; the private interest is potential export earnings. Two options explored below would help both parties reap benefits from agroenvironmental technology trade.

OPTION A: *Assemble an information base on trade in agroenvironmental technologies.*

Both public agencies and private firms need information about the status, trends, and obstacles confronting them in marketing agroenvironmental technologies abroad. Although the international trade market in environmental technology appears relatively open, the particular problems and opportunities for the agriculture sector have not been systematically investigated.

Ensuring sufficient effort to achieve environmental goals may require more than open private markets—some public activity may be necessary. NAAEC, for example, is investigating transborder environmental problems and how environmental technologies might be used to alleviate them. Public policies that discourage or inhibit particular technologies that promote environmental protection, such as burdensome registration proc-

esses for new chemical or biological pesticides, may require governmental attention. Congressional hearings on issues related to agroenvironmental technology trade could help assemble the first information base on the subject.

OPTION B: ***Authorize a multilateral public-private panel on agroenvironmental technology transfer.***

Environmental technologies seem to face relatively few trade barriers, as noted above, and little government involvement appears necessary to make the industry a beneficial force for promoting the health of the domestic and international environment. The full potential for sharing agroenvironmental technologies that address key transboundary and global environmental management questions cannot, however, be realized by private markets alone. Certain cases will require more government assistance.

Where transboundary or global environmental issues exist, the management problem becomes more difficult because multiple governments and complex negotiation become necessary. The protection of plant and animal species diversity that serves production and environmental needs outside one country's borders is a good example. Expanding agricultural production and environmental change in foreign countries from trade liberalization raises the issue of technology transfer to address these issues.

Convening an international panel on agroenvironmental technology transfer to design institutions and procedures for promoting the public and private diffusion and voluntary adoption of human, biological, and physical technologies would be a low-cost first step. Some programs already under way at the Organization for Economic Cooperation and Development are investigating ways to promote such transfers, and increased congressional attention would aid such efforts. Improved market access for U.S. companies would likely result from such initiatives, as well as public-private collaborative technology research and development.

EPILOGUE

This chapter has presented policy options for agriculture, trade, and the environment that illustrate how policies can be complementary rather than in conflict. As the United States heads into the next millennium such complementarity could have a key influence on the standing of U.S. agriculture in a global economy. Indeed, seeking complementarity among these policies will allow the United States to capture the opportunities of global market expansion while protecting and advancing domestic goals related to environmental quality as well as to the competitiveness of the agricultural sector. Moreover, seeking complementary and mutually reinforcing policies will likely lessen budget pressures. Equally important, pursuing complementarity can help ensure that the nation's policies are oriented to the future, not anchored to the past.

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