International Comparison of Agriculture, Trade, and Environmental Policies

6

As expanding trade puts new emphasis on the relationship between agriculture and the environment, it is prudent to examine what effects various policy responses to this relationship will have on national or regional economies, and on U.S. competitiveness in world markets. Are other countries experiencing agroenvironmental problems similar to those of the United States, and how do their responses compare with ours? If the United States regulates agriculture to preserve its environment, will it still be competitive in world agricultural markets? Do other countries offer more support to their agricultural sectors than the United States does? Do other countries restrict agricultural trade more, or less?

This chapter begins to put into perspective the relative position of the United States among its many trading partners with respect to domestic agricultural support policies and agroenvironmental policies. The partners considered here are Argentina, Australia, Brazil, Canada, France, Germany, Japan, Mexico, the Netherlands, New Zealand, Taiwan, and the United Kingdom—a group that includes most of the United States' major agricultural markets and sources of agricultural imports. With some exceptions, these countries share certain economic characteristics: generally, 10 percent or less of their populations are working in the agricultural sector, which accounts for between 2 and 5 percent of total gross domestic product (GDP). As a percentage of total exports, their agricultural exports span a broader range, from 0.4 percent for Japan to 58 percent for Argentina. The United States' agricultural exports make up 11 percent of its total exports. (See table 6-1 for general population and economic information.)

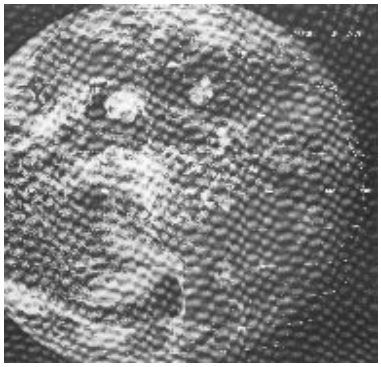

TABLE 6-1: Population and Economic Information

Country	Population (in 1,000s) 1992	Percent of population in agricultural economy	Total land (in 1,000s of Ha) 1992	Percent of land in agriculture 1992	Agricultural GDP as a percent of total GDP 1989	Agricultural exports as a percent of total exports 1991	Agricultural imports as a percent of total imports 1991
Argentina	33,100	10	**273,669**	10	10	58	**4**
Australia	17,611	5	764,444	6	5	24	**4**
Brazil	154,163	23	845,651	7	11	25	**12**
Canada	27,426	3	922,097	5	3	8	**6**
France	57,266	5	55,010	35	5	14	**9**
Germany[a]	80,343	4	34,931	34	FR 6	3	**12**
					NL 2	5	**11**
Netherlands	15,179	3	3,392	27	5	23	13
U.K.	57,963	2	24,160	27	2	7	11
Japan	124,150	6	37,652	12	3	0,4'	NA
Mexico	92,342	29	190,869	13	8	10	12
New Zealand	3,417	9	26,799	2	13	52	7
Taiwan	20,400	12	3,601	24	4	NA	NA
U.S.	254,910	2	916,660	20	3	11	5

[a]FR=Federal Republic, NL=New Lander

*1992

NA=Not Applicable

SOURCE: American Institute in Taiwan, Annual Report, *Agricultural Situation,* AGR Number TW3062, 1993; Food and Agriculture Organization of the United Nations, *Country Tables* (Rome, Italy: 1993); Food and Agriculture Organization, *Production Yearbook,* 1992, vol 46 (Rome, Italy: 1993), Food and Agriculture Organization, *Yearbook, Trade,* vol. 46 (Rome, Italy: 1992); U S Department of Agriculture, Economic Research Service, *International Agriculture and Trade Reports: Asia and Pacific Rim Situation and Outlook Series,* RS-93-6 (Washington, DC: September 1993)

Since 1970, agricultural production in OECD[1] countries has expanded by about 40 percent, even though arable and permanent cropland increased by only 3 percent and the agricultural labor force decreased by more than 30 percent. Such a jump in production largely reflects greater use of energy, fertilizers, pesticides, machinery, irrigation, and high-yielding crop varieties. Use of energy and tractors increased by 40 percent in OECD countries over the past three decades; use of nitrogen fertilizers, by almost 60 percent; and areas of irrigated land, by 20 percent (51). It is crucial to note that the increase in production would not have been possible without the support of government policies that, for the most part, did not take into account the environmental impacts of intensive agricultural practices. Now, however, governments are faced with increasing conflicts between long-standing agricultural policies and newly established environmental goals.

All of the countries considered in this chapter intervene in their agricultural sectors to achieve certain national objectives, such as maintaining a secure, safe, and adequate food supply; increasing agricultural productivity; and enhancing living standards of farm families. In recent years, however, budget constraints, international pressure, and socio-economic changes have led most countries to cut back on government support for their agricultural sectors. New Zealand went so far as to eliminate government support altogether in 1984, other than for pest and disease control and some research. Mexico and the European Union (EU) (until 1994, known as the European Community, or EC), have advanced efforts to separate, or "decouple," agricultural support from product prices. As part of its economic reforms, Argentina has drastically reduced the implicit tax it levies on its agricultural sector. Australia and Taiwan are the only countries among those considered that have not decreased their overall support to the agricultural sector in recent years, although Australia appears to be moving in that direction.

All countries use some combination of border measures—tariffs, quotas, export promotions, health and safety regulations, licensing schemes, and other devices—to protect domestic agricultural producers and enhance their opportunities to increase agricultural exports. Taken together, these measures can restrict overall world trade. However, through increased participation in regional trade blocs, such as the North American Free Trade Agreement (NAFTA), and in the World Trade Organization (WTO) (which was until January 1995 known as the General Agreement on Tariffs and Trade, or GATT), many countries are opening their borders to freer trade.

As noted earlier, this move toward freer trade, which has taken place over the past few decades, has coincided with (and in some cases has contributed to) growing environmental concerns and a range of government efforts to address those concerns. By the mid to late 1980s, most governments had instituted at least some environmental legislation and regulations, and had taken moderate measures to help mitigate problems. The implementation, enforcement, and effectiveness of these policies and regulations varies widely from country to country.[2] Among the industrialized countries, there is not a significant discrepancy in the percentage of GDP that is used for pollution abatement and control by the public and private sectors (see also chapter 5). The percentage of GDP spent by the public and private sectors com-

[1] OECD (Organization for Economic Cooperation and Development) member countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.

[2] When attempting to compare countries' agroenvironmental policies, it is important to note (1) that a country's state of environmental health must be known in order to determine whether action is even warranted, and (2) that the degree of implementation and enforcement is key to determining the efficacy of policies. This chapter looks only at trends in agroenvironmental policies, and does not systematically address points (1) or (2).

bined for pollution abatement and control ranges from 1.1 percent in France and Japan[3] to 1.6 percent in West Germany and the United States. Expenditures by the public sector alone range from 0.4 percent in the United Kingdom to 1.0 percent in Japan (table 6-2) (53).

TABLE 6-2: Pollution Control and Abatement Expenditures as a Percentage of GDP (1990)[a]

Country	Public sector	Public and private sectors
Canada	0.9	NA
u s	0 6	1.6
Japan[b]	1,0	11
France	0.5	11
W. Germany	0.8	1.6
Netherlands[c]	0.9	1,5
United Kingdom	0,4	1 5

[a]Data on the costs of pollution control in the primary agricultural sector are generally not included in calculations of pollution control and abatement expenditures because the data in this area are scarce
[b]Partial Figure Data of current expenditure for the business sector are not available
[c]Figures for 1989.

NOTE: Table 6-2 shows pollution and abatement control expenditures of both the public and private sectors for air and water pollution. These figures can give an idea of the economic costs a country chooses to face in mitigating pollution However, as a comparison these numbers cannot tell the reader anything about the current state of a country's environment, about the environmental state a country desires to achieve, or the amount of pollution control each country obtains per unit of currency For example, country A and country B could be spending the same percent of GDP on pollution abatement and control, but country A's environment might be twice as polluted as country B's

SOURCE: OECD, Environment Monographs, No 75, *Pollution Abatement and Control Expenditures in OECD Countries* (Pans, France 1993).

Although the nature and extent of the problems may vary, most countries are contending with similar agroenvironmental ills. Until recently, however, the agricultural sectors of most countries were largely excluded from environmental policies and regulations. Often, initial policies addressing agroenvironmental issues focused on soil erosion, because it directly affects agricultural productivity. As agroenvironmental priorities have broadened, however, many countries have begun to include provisions for enhancing water quality, as well as protecting habitats, wetlands, and other countryside amenities in their agricultural policies. Canada, Japan, and the United States have each eliminated their wetlands by more than 70 percent in some regions, but have now introduced policies geared to protecting remaining wetlands that are deemed significant, or to preventing a net loss of wetlands.

Most countries are grappling with the environmental effects of agricultural production by discouraging harmful practices or encouraging beneficial ones. It must be kept in mind, however, that agricultural assistance is still predominantly linked to production rather than to general environmental goals. To a large extent, existing agricultural policies either effectively raise farmers' prices for output or decrease prices for inputs—both of which encourage farmers to adopt intensive farming practices that may be harmful to the environment. Agroenvironmental policies may then be introduced to counteract these effects. However, the artificially high prices for agricultural goods make it difficult for other land uses, such as wildlife habitat, to compete with agricultural uses.

This dilemma is being addressed now by governments the world over. Faced with shrinking budgets, they are finding it more and more difficult to rationalize maintaining such conflicting policies—and they are increasingly unwilling to pay not only the' financial, but also the environmental, costs of supporting their agricultural sectors as they did in the past. Partly as a result, agroenvironmental policies are moving away from strictly voluntary efforts to cross-compliance schemes and mandatory measures. These policies may cause production costs to rise, but if all, or most, countries are implementing similar policies and all face increased costs, the ultimate effects on competitiveness may be minimal. U.S. farmers may face less severe tradeoffs between productivity and environmental protection than some of their European counterparts, because they

[3]This is a partial figure, as data on business sector current expenditure in Japan are not available.

use inputs less intensely and their arable land area is more extensive (62).

In the context of this chapter, it is not OTA's intention to determine which countries have cleaner environments, which countries have more stringent regulations protecting the environment, which countries have been more successful in implementing agroenvironmental laws, which countries have the freest trade policies, or which countries offer the most support to their agricultural sectors. Instead, the chapter focuses on the trends mentioned previously: movements toward less government support of the agricultural sector, more open borders, and more stringent, or at least explicit, agroenvironmental policies. The first section of the chapter briefly examines the agriculture and agricultural trade policies of each country. It demonstrates the many similarities among countries in their agricultural sector goals, in the problems they face, and in the evolution of events over the past few decades. The second section focuses on some of the environmental concerns increasingly being incorporated into agricultural policies and regulations. Examples again show remarkable similarities among countries in the kinds of agroenvironmental problems they face, and in their responses to those problems.

TRENDS IN AGRICULTURAL SUPPORT AND TRADE POLICIES

As noted above, all governments intervene in their agricultural sectors to achieve certain national objectives related to food supply and farm income. To achieve these objectives, governments employ combinations of price supports, subsidies, and market boards, as well as trade measures such as tariffs, quotas, export promotions, and licensing schemes. Health and safety regulations, although designed to protect consumers and the environment, can also be used to restrict trade. To varying degrees, these policies affect how domestic goods are produced, have negative effects on world market prices, and restrict international trade flows.

Such economically undesirable results, along with tighter budget constraints, have led governments to offer less support to their agricultural sectors than they previously did. Further fueling the move toward less support is the increasing importance of international trade agreements, which have put pressure on countries not only to reduce their trade barriers, but to cut back on domestic subsidies. Even though the Uruguay Round of the GATT put the agricultural sector squarely on the negotiating table, it is not clear to what extent government policies will actually change. However, most countries have already taken measures to reduce government support of their agricultural sectors.

In this regard, New Zealand is a unique example: it essentially eliminated government support for agriculture in 1984, and its government transfers to farmers are now the lowest in the industrialized world (69). Mexico has also taken significant steps to reduce government support by introducing, in 1993, an agricultural reform program called PROCAMPO, which decouples farm income support from production decisions and moves its agricultural sector significantly toward a market-directed system. The EU, too, has made efforts to decouple agricultural support from yield, although not to the extent of New Zealand and Mexico.

The extent of government transfer payments to agricultural sectors is commonly measured by using producer subsidy equivalents (PSEs). The Economic Research Service (ERS) of the U.S. Department of Agriculture (USDA) began calculating PSEs in 1986, for use in the Uruguay Round of the GATT negotiations. PSEs are intended to provide an overall measure of government policies that support agriculture, and so offer a means of comparing programs from country to country and over time. What they show, in effect, is the amount of compensation that would be required to maintain farmers' incomes in certain agricultural sectors, if government polices affecting agriculture (both agricultural and trade policies) did not

exist. This report uses an aggregate PSE for all agricultural sectors, which demonstrates the extent of subsidies or implicit taxes relative to farmers' gross revenues (73).[4]

An analysis of the percentage change in PSEs between 1985 and 1992 clearly demonstrates a trend toward less intervention by governments in the agricultural sector, including the elimination of many government-supported marketing boards (table 6-3). New Zealand's and Mexico's PSEs changed the most, decreasing by 91 and 73 percent, respectively.[5] The PSEs for the United States, the EU, and Canada decreased by 35, 33, and 9 percent, respectively. The increased PSE for the United States during 1991 and 1992 reflects, in part, an increase in direct payments as export subsidies for rice. Japan's PSE decreased by only 10 percent, and the PSEs for Australia and Taiwan increased. The change in PSEs for Argentina, dramatic at 66 percent, is unique because it does not reflect declining government subsidies for agriculture. Instead, Argentina has reduced the implicit tax on the agricultural sector in a move toward a more market-driven agricultural economy. The PSE for Brazil has varied widely, making it difficult to ascertain a clear trend. The policies and economic forces behind these trends are discussed in more detail in the country sections below.

New Zealand

In 1984, New Zealand initiated major reforms in the structure of its economy, including agriculture (the leading economic sector) and the highly protected manufacturing sector. An increase in the public debt, from 10 percent of GDP in the early 1970s to more than 50 percent of GDP in the early 1980s, was the impetus for the reforms. Part of the reason for the debt was New Zealand's loss of favored-nation trading status with the United Kingdom when the UK entered the Common Market. The United Kingdom had accounted for two-thirds of New Zealand's export market. But high oil prices, unfavorable conditions in the world commodity markets, and the protectionist policies of New Zealand's main trading partners also made the country's support for its agricultural and manufacturing sectors unsustainable.

Before the mid-1950s, New Zealand's agricultural sector had needed little government support. During the late 1950s and 1960s, however, commodity prices fell, and the government severely restricted imports, in order to stimulate expansion in its manufacturing sector. By the mid-1960s, the government had also introduced policies to maintain or increase agricultural production whenever farm incomes declined. From the mid-1970s, and particularly from 1980 to 1984, government intervention in the agricultural sector became extensive (57), even though its support could not offset excess costs indirectly imposed on agriculture from government protection of the manufacturing sector. Government protection of the manufacturing sector artificially increased farm input and labor costs. Such support also proved extremely expensive. By 1983, government assistance for the livestock sector, the country's primary agricultural sector, was more than 33 percent of the sector's total value (35). Support also stunted diversification efforts because it favored some products, such as sheepmeat, over others (57). More than half of government support to agriculture between 1980 and 1984 consisted of price supports and direct payments to boost output.

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[4] USDA/ERS notes four caveats pertaining to PSEs. First, variations exist in how policies are included in determining each commodity PSE and which commodities are included in determining the aggregate PSE. Variations here could significantly change the nature of the data. Second, some developing countries do not include the effects of exchange rate policies, which can be an important component in the PSE measure. Third, the reliability of the data varies from country to country. Fourth, a country can lower the percentage PSE without changing total transfers to producers merely by shifting transfers from indirect programs to price support programs or direct payments (73). This report uses the numbers to determine trends of government support within a country rather than among countries.

[5] Percent changes in PSEs, except for New Zealand and Argentina, are calculated by using the 1986, 1987, and 1988 average as a base year. This base was chosen because it was used during the GATT negotiations. For New Zealand and Argentina, 1985 was used as the base year to show the changes that resulted from their reform efforts prior to 1986.

TABLE 6-3: USDA Percent Producer Subsidy Equivalents for Various Countries

Country	Item	1985	1986	1987	1988	1989	1990	1991	1992	Percent change using 1986–1988 average as base year[a]
Argentina	4-commodity	-31.5b	-24.4	3.0	-175	-46,6	-65.6	-28.3	-10,8	+66[c]
Australia	9-commodity	9.4	10.9	7.5	6.7	6.4	9.9	NA	NA	+18
Brazil	6-commodity	26,9	30.8	-8.1	NA	NA	NA	NA	NA	NA
Canada	13-commodity	36.0	41,5	41,0	33.5	34,4	36.7	39,1	36.0	-9
European Union	13-commodity	357	477	51.4	38.1	30.1	NA	NA	NA	-33
Japan	10-commodity	70,0	76.9	78,7	77.4	71,0	70.8	NA	NA	-lo
Mexico	14-commodity	26.1	34.0	36.5	20.9	14,9	17,1	12,3	8.0	-73
New Zealand	5-commodity	22.0	9.0	5.0	3.0	2.0	NA	NA	NA	-91[d]
Taiwan	11 -commodity	24.6	24.7	24,7	25,9	29,2	28.6	28.3	31.6	+26[e]
U.S.	12-commodity	23.4	34.2	31.5	23.5	18,5	18.0	18.8	19.3	-35

[a]The end year used to calculate percent changes varies among countries and IS the latest year for which there are data.

[b]A negative number represents an implicit tax on the agricultural sector.

[c]The change in PSE for Argentina between 1985 and 1992 indicates that the implicit tax on agriculture has decreased by 66 percent

[d]Using only 1985 as the base Year

[e]The aggregate PSE for Taiwan increased even though there were no major policy changes that occurred during this period The increase IS due in part to high guaranteed purchase prices for all the crops included in the 11-commodity aggregate.

NA = Not Available.

SOURCE: U.S. Department of Agriculture, Economic Research Service, *Estimates of Producer and Consumer Subsidy Equivalents,* Statistical Bulletin 913 (Washington, DC December 1994).

The principal goals of deregulation and liberalization were to lower inflation and interest rates throughout the economy and to secure more favorable exchange rates. The agricultural sector initially supported these changes, and reform was essentially completed by 1988. Supplementary minimum price schemes were eliminated, along with low-cost funds provided to producer boards. The PSE for New Zealand decreased from 32 percent in 1982 to 2 percent in 1989. Most of the current support is in the form of research and training, pest and disease control, and natural disaster assistance. Although the effective rate of assistance to both agriculture and manufacturing has declined, assistance to agriculture has decreased more rapidly, resulting in an implicit 6-percent tax on agriculture. In 1991, the government introduced additional measures to reduce this implicit tax (35,57).

These reforms have had a powerful impact on New Zealand's agricultural sector. The severity of initial conditions, rapid implementation of the reform policies, imbalances in structural reforms among sectors, uncertain economics of world agricultural markets, and severe droughts in 1988 and 1989 have all contributed to a long and difficult adjustment period. However, the advantages of the reform measures are now evident. Overall, since policy reform, public debt has risen less rapidly than GDP, and fiscal surpluses are expected for 1994-1995 and subsequent years. The double-digit inflation rates of the 1970s and 1980s have dwindled to about 1 percent since 1990. Generally, reform has contributed to a more diversified and resilient agricultural sector. Specifically, reform has affected land use and values, the nature and quantity of input use, employment, investment, and trade.

Although data on farm size and land use are incomplete and do not allow for detailed analysis on land use changes, some trends can be discerned. On the whole, the number of large and small farms has increased (42,44). The percentage of farms whose debt exceeds 50 percent increased from 10 to 24 percent between 1984 and 1986, but by 1992, the percentage of these highly indebted farms decreased to 9 percent, as they either restructured their debt or were sold. At the other end of the scale, the percentage of farms with low debt increased from 14 to 21 percent between 1986 and 1992. These farms managed to increase their savings continuously throughout these years, with the exceptions of 1986 and 1989. The total area farmed decreased from 21.2 to 17.3 million hectares between 1984 and 1993. Conversely, though, the number of farms increased during the same period, from 76,633 to 79,666, and permanent full-time employees increased from 22,787 to 23,310 between 1984 and 1991 (35). Between 1982 and 1988, real farmland values fell by more than 50 percent, demonstrating the extent to which government support for agriculture was capitalized into the value of farmland. But by 1993, real land prices had risen to about 88 percent of their 1982 levels.[6]

Subsidies in place before reform heavily favored sheep production. Now, in the absence of subsidies, sheep production has declined, and beef and dairy production have increased (67). The number of sheep, for example, decreased from 70 million in 1982 to 52 million in 1992.[7] Without government subsidies, many sheep farms operating in marginal environments, such as high-country pastures, were no longer viable. Many of these areas were planted with private forests (35). The amount of land in forestry increased 39 percent between 1983 and 1993, while sheep, beef, and cropping land has decreased 10 percent (5). With the elimination of accelerated write-offs for machinery and development costs, as well as the elimination of import restrictions on cereal crops, arable farming has also declined. The fruit and vegetable sector, in contrast, has increased in area and value.

[6] Information supplied by the New Zealand Ministry of Agriculture and Fisheries, Agriculture Policy, External Relations, 1994.

[7] Information supplied by the New Zealand Ministry of Agriculture and Fisheries, Agriculture Policy, External Relations, 1994.

New Zealand's natural disaster assistance policy has also undergone extensive changes, to make it more consistent with overall economic objectives. The goal is to ensure that adverse-events assistance policy does not impede agricultural restructuring. Under a risk-sharing policy, for example, one area of New Zealand received assistance for drought every year from 1978 to 1986. The government has been working to tighten the criteria for eligibility. In 1986, specific meteorological criteria, such as soil moisture deficits, were developed to determine whether an event would be classified as "adverse" (43).

Agriculture contributed about 20 percent to New Zealand's GDP in the 1950s, but only 13 percent between 1990 and 1992. Overall, total agricultural exports have increased in real terms by 1 percent (183 percent in nominal terms) between 1984 and 1992. Exports of pastoral farm products (e.g., products from sheep) decreased, but exports of meat, dairy products, and fruit and vegetables increased. Although agricultural exports still dominate, they fell as a percentage of total exports from an average of 67 percent between 1979 and 1981 to 54 percent in 1991 (19).

Mexico

Mexico joined GATT in 1987, and since then has privatized much of its economy, including activities related to agriculture. Mexico's most recent and comprehensive agricultural reform policy, PROCAMPO (Programa de Apoyos Directos al Campo), was first announced in 1993. It is designed to move the country's agricultural sector closer to a market-driven system and to work in concert with NAFTA to liberalize trade. Average tariffs on imports have since dropped from 45 to 9 percent.

PROCAMPO replaces price supports, which were often well above international levels, with direct income supports. Input subsidies, except for electricity, have been abolished, and import licenses, tariffs, and state trading companies no longer offer the agricultural sector any significant protection (4). PROCAMPO should help diminish incentives for overproducing the commodities included in the program: corn, beans, wheat, rice, cotton, soybeans, safflower, barley, and sorghum. These are the crops planted by 85 percent of Mexico's agricultural producers. The program was initiated from 1993 to 1994, and should be fully implemented by 1995. For the first 10 years of the program, producers will receive fixed payments (in real terms), which will be phased out over the following five years. The Mexican government estimates that the program will initially increase its outlays in 1995, but reduce them in subsequent years (71). As part of its NAFTA commitment to liberalize trade with the United States, the government of Mexico has begun to upgrade its health and safety regulations, although the regulatory authorities have few resources with which to pursue their tasks (4).

The recent reform of Mexico's land tenure system has contributed significantly to the drastic changes taking place in Mexico's agricultural sector, because it allows increased participation by the private sector. Until 1991, article 27 of the Mexican Constitution of 1917 required the government to give land to any group of farmers who claimed property rights in accordance with the applicable legislation, even if it meant expropriating unused and underused land from private owners. Individuals could not own the land, but they could form communal groups called *ejidos*, and work the land collectively. Between 1917 and 1987, approximately 100 million hectares had been expropriated and more than 50 percent of Mexican farmland was operated under the *ejido* system. However, in an attempt to prevent the reappearance of large land holdings, *ejidos* could not sell, rent, or use the land for collateral before 1991.

Mexico's agricultural trade balance dropped from a surplus of 2.3 percent of GDP in 1960 to a 0.3 percent deficit by 1980. Despite its very favorable conditions for agriculture, Mexico has become a net importer of food (including maize and wheat). Partly in response, a 1991 amendment to the country's constitution paved the way for corporate investment, joint ventures, and private ownership of *ejidos*, to encourage modernization. These changes are intended to provide more secu-

rity to agricultural land investors, protect against expropriation, allow *ejidos* to rent their land, and create a foundation for greater capitalization of the agricultural sector. New investors seem particularly interested in the prospect of growing fruit and vegetables. Although the new legislation does not change the allowable size of individual land holdings (100 hectares of irrigated land for row crops per individual, 300 hectares for orchards, or enough land for 500 head of cattle), it allows the creation of associations or corporations that can own up to 25 times the amount that individuals can own (2,500 hectares of irrigated land for row crops, 7,500 hectares for orchards) (10).

These reforms are creating significant adjustment problems. In the long term, as many as 90 percent of Mexico's 2.4 million maize producers could be dislocated, and overall, a total of 3.5 million small and medium-size farms (10,85). Dislocation in the short term could be limited not only because investors might find it difficult to acquire fragmented land, but also because they might move cautiously at first, waiting to see how the new law plays out in the courts. There has also been a sharp decline in the agricultural share of GDP as the nation's economy has expanded: agriculture as a percentage of total GDP was 8 percent in 1989, but dropped to 5.8 percent by 1993 (4,19). In addition, input prices have risen as commodity prices have fallen, affecting the use of fertilizers, pesticides, and improved seeds. According to the American Embassy in Mexico City, farm organizations have orchestrated large demonstrations to demand some transitional help, such as the restructuring of outstanding loans (4). Estimates of farm loans in default range as high as $4 billion. The government decided that its bank, which holds approximately 33 percent of delinquent loans, would stop seizing assets in response to loan defaults (61).

USDA estimates that the policies of PROCAMPO will lead to lower producer and consumer prices for all crops in the program. Lower producer prices should lead to fewer acres planted with corn—an estimated 700,000 hectares in the first three years. At present, Mexico's primary crop is corn, which accounts for more than half of Mexico's cropland and more than 40 percent of the country's total crop value. About 34 percent of corn output is consumed on the farm, which means that many farmers have not benefited from price supports. Consequently, their farming decisions will not be affected as much as commercial farmers, who have benefited from the price support system. Subsistence farmers will, however, benefit from direct income support payments, because the payments are based on the amount of land historically planted in eligible commodities (71).

In addition to NAFTA, Mexico has entered into free trade agreements with Chile (1991), with the Latin American Association for Integration (ALADI), and with the Central American Common Market (MCC). Trade with Chile grew by 50 percent between January and June 1992, and by 30 and 32 percent with ALADI and MCC, respectively, during the same period. Mexico is also pursuing negotiations with Colombia and Venezuela, as well as with the Asian-Pacific Economic Cooperation group.

European Union

Like the United States, the EU has been struggling in recent years to change agricultural policies and practices that, while arguably relevant decades ago, do not reflect the realities of the 1990s. In the 1950s, when the Common Agricultural Policy (CAP) was instituted, European agriculture employed a full 26 percent of the total workforce (compared with 12 percent in the United States in 1955), and was a highly relevant part of the European economy. Nonetheless, the living standards of European agricultural workers lagged behind those of urban workers, just as European farming practices and technology lagged behind those of other parts of the world (9). Consequently, the original objectives of the CAP were to increase agricultural output through capitalization and technology, to improve the living standards of agricultural producers, stabilize agricultural markets by protecting the sector from international price fluctuations, ensure an abundant supply

of food, and establish reasonable prices for consumers.

After three decades, the objectives of the CAP have largely been met—but the environment in which the European agricultural sector operates has become qualitatively different. The EU has changed from a net agricultural importer to the world's second-largest exporter. Income gains have been realized, but have not been equally distributed: the top 25 percent of farmers, who make 80 percent of all agricultural sales, have gained the most. Overall, in real terms, farm income unambiguously slipped between 1970 and 1992 (84). As in the United States, operators of small and medium-size farms began to rely more and more on income generated off the farm. European agriculture's contribution to the region's GNP has decreased, and the agricultural labor force has shrunk even as production and productivity have increased. "While in the first years of the EU's existence there was a general consensus to pursue policies aimed at increasing production and economic returns, the last decade has witnessed the growth of a more socially oriented political agenda. The latter is a part of the emerging support for environmental, food, and natural resource issues" (9).

These new concerns are largely unrelated to production issues of the past. Although commodity organizations resisted any reform in the CAP, they came under increasing pressure from other politically organized groups, both within and outside agriculture, to support changes. The greatest impetus for change, however, was the financial burden imposed by current policies under the CAP, which, all told, absorb 70 percent of the EU budget. Generally, reform proponents wished to reduce agricultural supply, diversify production to target changing consumer demands, target assistance to low-income farmers, decouple assistance from the amount and type of commodity produced, and bring agricultural policies more in line with environmental policies.

In 1992, the EU adopted CAP reforms designed to steer the agricultural sectors of members away from price supports and toward land area payments over a period of four years. The reforms apply to all products incorporated in the common market organization, with the exception of sugar, wine, fruit, vegetables, pig meat, poultry meat, and eggs. The three main reforms include lower price supports, land area payments that are decoupled from production levels, and arable land set-aside schemes that offer farmers compensation payments. In the case of land area payments, a switch from a per-unit to a per-hectare payment effectively ensures that payment is not based on yield (36). Under this new regime, cereal crop intervention prices were lowered by about 33 percent. To compensate for the lower price, farmers who produce more than 92 tons of grain are required, and paid, to set aside 15 percent of their arable area for five years. The land set-asides apply to the total cultivated area, rather than to each crop area, and the area payment rises in line with price support reductions. For milk, milk products, and beef, reform measures decreased intervention prices by 2.5 to 15 percent (45).

In 1993, the EU Commission moved to make the set-aside program more flexible by offering three-year rotational set-asides, under which 18 percent of arable land would be taken out of production; and a combination of rotational and nonrotational set-asides, under which a minimum of 20 percent of arable land would be taken out of production. One proposal suggests that farmers be allowed to set aside more than the minimum required amount of arable land (although such a scheme might pose budgetary problems). According to the Food and Agriculture Organization (FAO), less than 1 percent of the then-EC's arable land was covered under the set-aside program in its first year of operation (15). In 1993, set-asides in the 12 EU member states were estimated to be 13.1 percent. The figure for the United Kingdom was 15.6 percent; for France, 13.3 percent; for Germany, 15 percent; and for the Netherlands, 5.3 percent (3).

Canada

Like most of the countries covered here, Canada saw its PSE decline in recent years. This phenomenon is, however, less a reflection of explicit policy than of changing levels of support for individual commodities. Support has remained relatively low for livestock, moderate for poultry, and high for dairy products. Support for grains and oilseeds, on the other hand, has varied. It increased markedly after the mid- 1980s, when international price competition grew fiercer (73).

Generally, Canada's agricultural tariffs are low, averaging 2 percent or less in 1991 for grains, fresh meat, and dairy products. Almost 95 percent of Canada's agricultural tariff lines are bound, which means that it cannot increase any of them without first going through official GATT procedures and addressing comments from other countries. Canada also maintains quantitative border restrictions for dairy, eggs, and poultry, as well as restrictions on domestic production. The country's dairy sector is oriented toward local markets and meeting domestic demands; its wheat sector, conversely, is geared toward exports. Canada is one of the world's toughest competitors in international grain markets. The goal of its wheat support programs is to moderate the effects of fluctuations in world markets on domestic prices and incomes. But transportation subsidies and price supports have not fully offset the losses in income stemming from a continuing drop in world cereal prices (21,22). Total financial assistance to agriculture amounted to 57 percent of Canada's agricultural GDP from 1988 to 1989. As with the EU, public assistance has not prevented Canadian farm incomes from declining. They have been decreasing since 1988.

United States

In 1991, the United States exported $37.6 billion worth of agricultural goods. The agricultural trade surplus represented 0.3 percent of GDP in 1992, compared with 0.9 percent in 1980. The top three agricultural export markets for the United States are Japan, Canada, and Mexico, which accounted for 21.12, and 8 percent, respectively, of U.S. exports in 1991 (74). (See table 6-4.) The principal U.S. export crops include feed grains, soybeans. live animals and meat, wheat, cotton, vegetables, and fruits. The United States controls 77 percent of the world export market for corn and 73 percent for sorghum. (See table 6-5.) The most competitive grain market it faces is the world wheat market. The United States controls 31 percent of that market; Canada and the EU control 22 percent each. Because the United States' share of world production or world trade of grain, meat, oilseeds, and sugar is so large, U.S. farm policies have a major impact on world export markets for these and competing products.

TABLE 6-4: Top Ten Export Markets for U.S. Agricultural Products, 1991

Country	Billions on dollars
Japan	7.74
Canada	4,41
Mexico	2,88
S. Korea	2,16
Former U.S.S.R.	1,76
Taiwan	1.74
Netherlands	1.56
Germany	1,13
U.K.	0.88
Spain	0.86
Total	37.60

SOURCE: U.S. Department of Agriculture, Foreign Agricultural Service, *Foreign Agriculture* (Washington, DC December 1992)

The United States continues to use high tariffs to protect sugar and tobaccos, and it employs import quotas to protect dairy products, cotton, peanuts, sugar, and beef and veal. Wheat, coarse grains, rice, oilseeds, cotton, tobacco, and dairy are still heavily subsidized and therefore have significant competitive advantages in the world market. Nevertheless, the PSEs for both wheat and barley decreased by more than 40 percent between 1987 and 1992. The PSEs for dairy, beef, and sugar also fell, between 12 and 21 percent; the rice PSE, in contrast, increased 8 percent. Income support payments decreased by 55 percent during the same period, and input assistance transfers dropped by 59 percent (73). The decline in input

TABLE 6-5: Production and Trade Information for 1990-1991

Production		Export		Import	
Country/commodity	Percent of world production	Country	Percent of world exports	Country	Percent of world imports
Corn					
u s	42	us.	77	Japan	28
China	20	China	12	U. S. S. R.*	18
Brazil	5	Argentina	6	Taiwan	9
EU	5	Canada	0.3	EU	6
Mexico	3	EU	0.2	Mexico	3
Argentina	2				
Sorghum					
U.S.	33	U.S.	73	Japan	45
India	27	Argentina	17	Mexico	38
China	8	Australia	3	Taiwan	1
Mexico	5				
Argentina	3				
Australia	2				
Wheat					
U S. S. R.*	18	U.S.	31	Other	42
China	17	Canada	22	U. S. S. R.*	16
EU	14	EU	22	China	10
U.S.	13	Australia	13	Japan	6
India	8	Argentina	5	Brazil	3
Canada	6				
Australia	3				
Rice					
China	36	Thailand	32	Others	66
India	22	U.S.	18	Brazil	7
Indonesia	9	EU	8		
Thailand	3	Australia	4		
Japan	3				
Oilseeds					
U.S.	28	U.S.	47	EU	37
China	15	Argentina	15	Japan	19
Brazil	8	EU	10	Mexico	6
Argentina	8	Canada	8		
EU	5	Brazil	6		
Canada	3				
Cotton					
China	24	U.S.	34	Others	41
U.S.	18	U. S. S. R.*	9	Japan	12
U. S. S. R.'	14	Australia	6		
Brazil	4				
Beef and Veal					
Us.	22	EU	24	Us.	31
U. S. S. R.*	18	Australia	22	Japan	15
EU	17	Us.	12	EU	13
Brazil	7	New Zealand	9	U. S. S. R.*	8
Argentina	5	Argentina	8	Canada	6
		Brazil	6	Brazil	5

(continued)

TABLE 6-5 (Cont'd.): Production and Trade Information for 1990-1991

Production		Export		Import	
Country/commodity	Percent of world production	Country	Percent of world exports	Country	Percent of world imports
Dairy Products**					
EU	42	EU	45	U. S. S. R.*	20
U.S.	19	New Zealand	20	Japan	19
U. S. S. R.*	11	Australia	11	EU	13
New Zealand	3	U.S.	6	Us.	10
Australia	2	U. S. S. R.*	1	Australia	2

*Former U.S.S.R
**Dairy products Include butter, cheese, and nonfat dehydrated milk

SOURCE: U.S. Department of Agriculture, Foreign Agriculture Service, *Foreign Agriculture* (Washington, DC December 1992) and *Dairy: World Markets and Trade,* FD-1-95 (Washington, DC: April 1995)

assistance transfers is accounted for mainly by decreases in credit subsidies for operating and real estate loans, and for commodity loans through the Commodity Credit Corp.

Agricultural export promotion programs received 75 percent of the total spent in fiscal year 1991 on promoting all U.S. exports. Approximately 21 percent of U.S. agricultural export revenues are supported by government subsidies. (See chapter 3.) These programs include the Marketing Promotion Program, the Public Law 480 food aid program, the GSM-102 and 103 export credit programs, the Export Enhancement Program (EEP), and the Dairy Export Incentive Program. Under EEP, 74 percent of U.S. exports of barley, and close to 60 percent of wheat and frozen poultry exports, were subsidized in 1993. Since 1991, the United States has spent more on EEP and has targeted three new countries under the EEP wheat program. It has also applied an antidumping duty on New Zealand kiwi fruit of 100 percent, which has made it impossible for the fruit to be imported, and has tightened quotas on meat imports. Federal outlays for domestic milk support fell to $125 million in 1993, down from $2 billion in 1987. Subsidies still exist, however, and are often 75 percent higher than the subsidized item's export price (24).

The Agricultural Adjustment Act of 1933 continues to restrict the imports of dairy products, peanuts, cotton, and sugar. Imports of sugar above the tariff quota were subject to a tariff of roughly 76 percent, which was reduced 13 percent in 1992. Under the provisions of the GATT Uruguay Round, the United States will replace the current tariff-rate quota for sugar with a tariff equivalent of 17 cents per pound, which will be reduced 15 percent (the minimum required) by the year 2000. Tobacco imports face a high tariff of 46 percent, and U.S. manufacturers are required to use 75 percent domestically grown tobacco in their products.

Japan

Japan is the largest net agricultural importer in the world. The United States supplies 36 percent of Japan's agricultural imports, including 87 percent of its corn imports, 73 percent of soybean imports, 53 percent of wheat imports, 42 percent of fresh fruit imports, and 55 percent of beef and veal imports. Japan is the world's largest foreign market for U.S. farm products, accounting for 20 percent of all U.S. agricultural exports. Despite its large agricultural purchases, however, Japan is under pressure from its international trading partners to open its markets to a wider variety of agricultural imports, especially high-value, processed products.

Japan's agricultural policies of the past half-century were greatly influenced by the country's experience of food shortages during and after World War II. In 1943, Japan enacted the Staple Food Control Act, which put domestic distribution of major food items, including rice and rice trade, wheat, and barley, under state control. Food shortages continued until the late 1950s, when Ja-

pan's agricultural sector began to recover. Japan attained self-sufficiency in rice by the late 1960s, and by the 1970s it began yielding surpluses.

To achieve its agricultural policy objectives, Japan uses a combination of border measures such as quotas and tariffs, direct price supports to producers, and subsidies on agricultural inputs. Rice, wheat, and barley farmers receive most of the agricultural assistance provided by the government. Until recently, rice accounted for 50 percent of Japan's agricultural policy costs. Japan maintains supply controls on milk and rice, and quasi-governmental bodies, such as the Livestock Industry Promotion Corp., operate price support regimes for certain dairy products and sugar, as well as price stabilization schemes for beef and pork. The government also offers deficiency payments for feeder calves, soybeans used for food, and milk for processing.

Agricultural policies were modified to adjust to Japan's rapid economic growth between the 1950s and 1970s. During this period, much of the agricultural labor force shifted to the manufacturing sector, and agriculture as a percentage of GDP decreased from 9 to 3 percent (66). Between 1961 and 1992, the labor force in agriculture decreased from 26 to 12 percent. To shield the agricultural sector from the effects of displacement, the Japanese government enacted the Agricultural Basic Law in 1961. The law aimed to reduce the disparity between urban and rural living standards, to raise productivity by increasing farm sizes, and to tailor production to the changing demands of Japanese consumers.

In the early 1980s, Japan began a further, gradual reform of its agricultural policies in response to growing rice surpluses. The Rice Paddy Agriculture Establishment Program, through production quotas and financial incentives for planting alternative crops to rice, has succeeded in diverting about one-third of all paddy land to other crops, such as soybeans and wheat—crops that were being imported in large numbers—and vegetables. It has also succeeded in reducing rice production by one-fifth. Until 1984, the government also subsidized the sale of rice in the world market and sold it cheaply for use in industrial processes and for feed. Support prices for rice were reduced in 1987, 1988, and 1990, and government control of rice marketing has loosened to the extent that private firms may purchase directly from farmers instead of through the Government Food Agency (23).

Although the economic importance of rice in Japan has been declining, it is still high, accounting for 47 percent of the gross value of agricultural production in 1960, and 29 percent in 1989. Seventy-five percent of Japanese farm households produce rice and 56 percent market rice. A significant decline in rice self-sufficiency—that is, a move toward importing more rice—would have far-reaching consequences (87). More than 50 percent of Japan's farmers are over 60 years old, and they could have a particularly difficult time adjusting to a more liberal rice market. On the other hand, only one-fifth of farm households are financially dependent on farming. For the remaining four-fifths, farming accounts for only 15 to 20 percent of household earnings.

The average household income of full-time farmers lags behind that of part-time farmers and urban households. A recent policy proposal by the Ministry of Agriculture, Forestry, and Fisheries, dubbed New Directions, targets government support to full-time farmers (70).[8] New Directions also advocates maintaining border measures, to ensure that Japan maintains its self-sufficiency in producing various foodstuffs. The fundamental structure of the staple food control system and the production quota system for rice remain essentially unchanged in the New Directions proposal.

[8] Recent legislation includes the Act for the Improvement of the Basis of Farm Management (1993). This legislation supports the policy proposals of the Basic Direction of New Policies for Food, Agriculture, and Rural Areas (1992) of the Ministry of Agriculture, Forestry, and Fisheries.

Most of Japan's high tariff rates are imposed on agricultural and food products, rather than on manufactured products. However, in the GATT Uruguay Round, Japan agreed to convert its import barriers on agricultural products (except for rice) to tariffs, and to reduce its bound tariffs by an average of 36 percent over a six-year period beginning in 1995. There is to be a minimum reduction on each tariff line of 15 percent (79). Japan also agreed to allow rice imports equivalent to 4 percent of domestic consumption in 1995 and equivalent to 8 percent of consumption in 2000.

One group of Japanese economists at the University of Tokyo's Agriculture Department found that open trade in rice would cut Japanese consumers' demand for domestic rice by two-thirds (87). In this case, Japan's self-sufficiency rate would fall to 33 percent. Over the next decade, the government would like its rice sector to increase paddy productivity and become more internationally competitive. Japanese farmers currently cannot compete because key rivals such as Thailand and the United States have larger (100 to 200 times larger) and more efficient farms, and/or significantly lower wage rates. Until Japanese farmers can become more competitive, the government will continue to protect them.

Japan's PSE fell 10 percent between 1985 and 1990,[9] reflecting a decline in government support for all commodities. Lower producer prices accounted for most of the reduction. Border measures remain the government's strongest form of support.

Argentina

Until recently, Argentina was the only country of those considered in this chapter to rely on its agricultural sector for resources to support industrial development. But in 1991, Argentina introduced policies to deregulate, decentralize, and privatize its economy, in an effort to reduce these transfers. Export taxes— including export taxes on all agricultural products except unprocessed oilseeds— were eliminated and exchange rate regimes reformed (20). Such policy changes decreased the implicit tax on the agricultural sector by 66 percent between 1985 and 1992 (73). Along with other trade liberalization measures, they should also help reduce the costs of agricultural production in Argentina and increase demand for its products abroad. Argentina's agricultural sector consequently has a great opportunity for expansion, mainly through productivity gains but also through increased acreage. Investment, especially in infrastructure, is extremely important for future growth.

Agriculture and agri-based products have often constituted 70 to 80 percent of Argentina's total export earnings. Oilseeds, fats, and oils are the country's most valuable export commodities. Because two-thirds of the world's annual trade in wheat is exported with subsidies, credit guarantees, or as aid, Argentina has had difficulty competing in the world wheat market in past years. Its share in the world wheat market has declined by 50 percent since the 1950s.

Australia

Australia is one of only two countries examined here whose PSEs rose since 1985. (See table 6-3.) Australia's higher PSE does not, however, reflect new policies advocating increased government support for agriculture. In fact, the overall level of support for agriculture in Australia has remained relatively low and essentially stable since 1982. The PSE jump stems in part from a large payment made to the country's wheat producers in 1986, which was triggered by a drop in world wheat prices below Australia's guaranteed minimum price (GMP). It was the first GMP payment since 1973. In 1989, a new Wheat Marketing Agreement deregulated the domestic wheat market, and the country's embargo on sugar was replaced with a tariff-rate quota (73).

Although Australia's PSE has not changed significantly, some major policy changes toward less

[9] Using an average from the years 1985 to 1987 as a base.

government intervention are taking place. Estimates indicate that the PSE decreased by 4 percent and 6 percent in 1991 and 1992, respectively (51).

Taiwan

Once based on agriculture, Taiwan's economy has come to be firmly rooted in industry. In the early 1970s, agriculture accounted for 30 percent of Taiwan's GDP; by 1991, it represented only 4 percent. Taiwan is currently a net importer of agricultural goods: primarily bulk commodities, such as feed grains, and intermediate agricultural products.

Between 1953 and 1968, Taiwan's agriculture sector was heavily taxed to supply the bulk of the resources necessary to fuel a new industrial sector. In addition, to ensure that it would have the amount of rice it deemed necessary for economic stability, the government controlled rice production, marketing, and trade. Subsequently, however, the government shifted from taxing agriculture to subsidizing it. Restrictive border measures initially intended to protect scarce foreign exchange now served to protect the domestic agricultural sector (34). Then and now, trade barriers in the form of very high tariffs, an import-licensing system, and import bans hinder imports of most agricultural products, including rice, wheat, sugar, tobacco, milk, and beef.

In the 1950s, agriculture represented about 90 percent of the value of all exports from Taiwan, but from 1960 to 1964, its share dropped to 62 percent. From 1985 to 1989, the figure was 7 percent. Farm crops account for 44 percent of the value of agricultural production; fisheries, 28 percent; and livestock, 27 percent (60). Rice production accounts for 40 percent of the country's crop acreage and approximately 80 percent of all government expenditures on crops (33). Although the total area planted in rice has been decreasing since 1965, productivity per hectare has increased over the years, due in part to increased chemical inputs, improvements in rice varieties, and improved irrigation practices (33). Prices for rice, corn, sorghum, soybeans, and sugarcane are artificially supported through programs designed to ensure supply and increase farm income. Domestic prices for these products are much higher than world market prices.

Although Taiwan's agricultural sector benefits from price supports, high tariffs, and import bans, production levels for most crops, except vegetables, are declining (74). The government abandoned unlimited purchase of rice in 1976 because it lacked sufficient storage space and funds. Further, to reduce production to a level that would meet domestic demand only, the government introduced control measures in 1984 that included riceland diversion, rotation, and set-aside programs. In contrast, hog and pork production has been increasing, although the environmental problems presented by porcine waste, as well as economic pressures, may adversely affect the sector in coming years.

Taiwan applied to join GATT in 1990. Two years later, the GATT ruling council voted to grant Taiwan observer status and to accept its membership application for review. As a result, Taiwan is trying to make its agricultural and trade policies consistent with the GATT requirements (74). The country's government is currently considering two reform measures: direct income supports for farmers, with the gradual elimination of supports for production; and incorporation of the hitherto unpaid costs of production—such as environmental degradation—into the cost of agriculture. Taiwan has asserted its commitment to reducing tariffs by up to 20 percent on 483 items in 1994 (79). However, since the government abandoned martial law in 1987, farmers have become an outspoken political force, and they strongly support agricultural subsidies. Politically, it will be difficult for Taiwan to eliminate or reduce these subsidies enough to conform with GATT requirements.

The increase in Taiwan's percentage PSE is not due to any explicit change in government policy. It can be attributed in part to the appreciation of Taiwan's currency since 1985, changes in world prices, and changes in domestic prices. Taiwan offers high guaranteed purchase prices for all of the commodities used in calculating its PSE, and, as noted above, maintains restrictive border measures.

Taiwan's Council of Agriculture, through its 1991-1997 Agricultural Adjustment Plan (AAP), intends to ensure domestic food security, make the highly protected agricultural sector more market-oriented, achieve zero agricultural growth through 1996, move toward a more environmentally sound agricultural policy, and increase rural incomes from 70 to 80 percent of urban incomes. The plan has successfully reduced production of subsidized agricultural products such as rice and sugar, but it does not dismantle the system of artificial support for agriculture. AAP has increased public awareness of what changes the nation must expect as it pursues GATT membership (6).

Brazil

In 1990, Brazil initiated major reforms in its economic and agricultural policies making them more open to world markets. It lifted almost all nontariff barriers to trade and export controls, reduced tariffs, revamped its monetary system, and initiated a privatization program. Specific reforms of note have included the Brazilian government's moves to decrease the country's average tariffs from 32 to 14 percent over the period 1990 to 1993; lift restrictions on soybean imports and exports, as well as on grain imports; and relinquish its 25-year control of wheat marketing.

Brazil generally supports domestic market crops (rice, wheat, corn) more than export market crops (soybeans, beef, poultry). As a result, some Brazilian producers have a difficult time competing internationally. Poultry, for example, which receives a 6.2 percent subsidy in the United States, is subjected to a 7.6 percent tax in Brazil.

ENVIRONMENTAL PROVISIONS IN AGRICULTURAL POLICY

Environmental awareness in most countries increased during the 1960s and 1970s. Although the approaches to environmental problems and the philosophical underpinnings of government action varied, most governments had at least some environmental legislation and regulations in place by the mid to late 1980s. The implementation, enforcement, and effectiveness of these policies and regulations has differed from country to country.[10]

Most countries have been slow to incorporate the agricultural sector into their environmental policies, programs, and regulations. Except in the case of product and safety standards, producers have faced few restrictions in choosing inputs and technology, and have felt relatively free to alter their landscapes to increase production. In the United States, for example, return flows from irrigation are not covered under the Clean Water Act, and pesticide programs have focused on chemical production rather than chemical use by farmers (88). However, many countries now recognize that they have achieved, or are currently achieving, the objectives of agricultural policies at the expense of the environment. (See chapter 4 for a discussion of how agricultural practices affect the environment.) Countries now recognize than many agricultural practices and established agricultural policies are in conflict with their more recently developed environmental objectives. As they contend with environmental problems stemming from agricultural practices, governments are generally pursuing more restrictive agroenvironmental agendas. This trend reflects changing environmental values, greater scientific understanding of the links between agricultural practices and environmental quality (15), and earlier efforts to tackle point source pollution that were not fully successful in achieving the desired environmental quality. Among the items on the new agendas are programs to align economic signals with environmental goals, such as policies that attempt to decouple financial support from agricultural product prices and reduce incentives to use agrichemicals. Regulations and programs that restrict fertilizer

[10] As noted earlier, it is important to be cautious when attempting to compare the agroenvironmental policies of different countries. The country's state of environmental health must be known in order to determine whether action is even warranted, and the degree of implementation and enforcement should be addressed as a means of determining the efficacy of policies. This chapter examines trends in agroenvironmental policies only. It does not systematically address the aforementioned issues.

and pesticide use to protect water quality, wetlands, and wildlife habitats, as well as preserve the countryside for recreational uses, are also on the rise.

In Canada, the Sustainable Agricultural Initiative of the 1990 Green Plan addresses the need for the agriculture industry to operate in a more "environmentally rational" way. The Canadian Green Plan allows the federal minister of agriculture, the provinces, and the private sector to enter into initiatives that include measures to halt soil degradation, develop shelterbelts,[11] provide stable supplies of clean water, make agriculture and wildlife more compatible, manage pollution, protect and use genetic resources, limit greenhouse gas emissions, and improve energy efficiency on farms (25). The country's Farm Income Protection Act requires periodic assessments of the environmental impacts of all programs implemented under the act (22). Environmental impact assessments have become an important feature of Canadian agricultural policy. The act also permits insurance to be withheld, restricted, or enhanced for the purpose of protecting the environment.

Financial assistance programs, integrated pest management programs, and research on "biorational" products and soil conservation are all contributing to Canada's desired transition to sustainable development. Nonetheless, institutional barriers still present a primary obstacle to the transition (39). The Canadian Wheat Board's system of quota allocations, for instance, is tied to "improved" land—a stipulation that encourages farmers to bring marginal land, which is often particularly susceptible to degradation, into production. In addition, payments made through the Western Grain Stabilization Act are tied to past output, which again encourages farmers to focus on high output regardless of how sustainable their practices are (81).

The EU has taken several steps over the past decade to formally address environmental problems resulting from agricultural practices. It is integrating environmental concerns into the formulation of agricultural policy, modifying existing agricultural policies to reduce their negative environmental impacts, and employing economic incentives for farmers to use environmentally benign land management practices. The EU began incorporating measures into the CAP to restrict production and promote environmental quality in the early 1980s, and the 1992 CAP reforms have continued this effort by incorporating a package of environmental measures associated with agricultural practices. The measures are all voluntary and offer farmers annual payments for implementing certain land management practices (32). The measures include:

- creating new environmentally sensitive areas (ESAs). These are designated areas in which farmers may voluntarily abide by certain management practices in return for compensation.
- allowing the public to use ESAs.
- creating new nitrogen sensitive areas (NSAs). These are areas where nitrate concentration in groundwater exceeds 50 mg/l.[12]

Other practices, such as preserving salt marsh habitats and moorland vegetation, and using organic farming methods, are also eligible for financial assistance. The funds for these measures represent about 5 percent of total CAP expenditure.

The United States is also broadening its agroenvironmental agenda to include, in addition to soil conservation, water quality improvement and protection of wildlife habitat. (See chapter 4.)

Most agroenvironmental problems fit into the following three categories identified by an FAO

[11] A shelterbelt is a row or rows of trees or shrubs that help protect crops from storms and protect soil from wind erosion.

[12] The EU and the United States use different methods for measuring nitrate levels. The EU measures the level of nitrate concentration by measuring the whole NO_3 molecule; the United States measures the level of nitrate concentration by measuring just the nitrogen (N) component of the molecule. The U.S. drinking standard of 10 mg/l is roughly equivalent to the European standard of 50 mg/l (50 mg/l of nitrate measured by the EU method is equivalent to 11 mg/l of nitrate measured by the U.S. method.) (41)

TABLE 6-6: Threatened[a] Mammals, Birds, and Fish (late 1980s)

Country	Mammals		Birds		Fish	
	Species known[b]	Percent threatened	Species known	Percent threatened	Species known	Percent threatened
Canada	193	6.2	514	3.3	1,066	4.4
U.S.	466	10,5	1,090	7,2	2,640	2.4
Japan	188	7.4	668	8.1	207	10.6
Australia	349	12.3	760	3.4	3,592	0.4
New Zealand	78	2.6	282	15.2	1,061	0.8
France	115	50.4	353	37.4	75	22,7
Germany	94	39.4	237	28.3	70	70
Netherlands	66	28.8	170	22.4	34	79,4
U.K.	44	NA	520	28.3	341	2.6

[a]The classification of "threatened" refers to the number of species considered endangered or vulnerable. The definitions are applied with varying degrees of rigor in Member countries, although international organizations such as the International Union of Concerned Scientists and the OECD are promoting standardization
[b]The number of species known does not necessarily reflect the number of species in existence.

SOURCE: Organization for Economic Cooperation and Development, *Environmental Data Compendium1993* (Paris, France 1993).

conference on the socioeconomic aspects of environmental policies in European agriculture (15):

- pollution and contamination of soil, water, air, and food, resulting from increased use of agrichemicals and excess amounts of livestock effluents;
- deterioration of the quality of natural resources, including soil, water, forests, and traditional rural landscapes;
- reduction in wildlife species and habitats, and loss of biological and genetic diversity.

The extent and severity of these problems varies not only among but also within countries, as the environment ability to absorb waste and contaminants is not uniform. Agricultural practices detrimental to the environment in one area maybe environmentally benign in another.

The next sections look at agroenvironmental policies, programs, and trends in several countries. The sections specifically address habitat destruction, as well as water contamination from nitrate fertilizers and livestock, as examples of common agroenvironmental problems. Both the problems and policy responses are outlined.

Protecting Wildlife Habitat from Intensive Farming

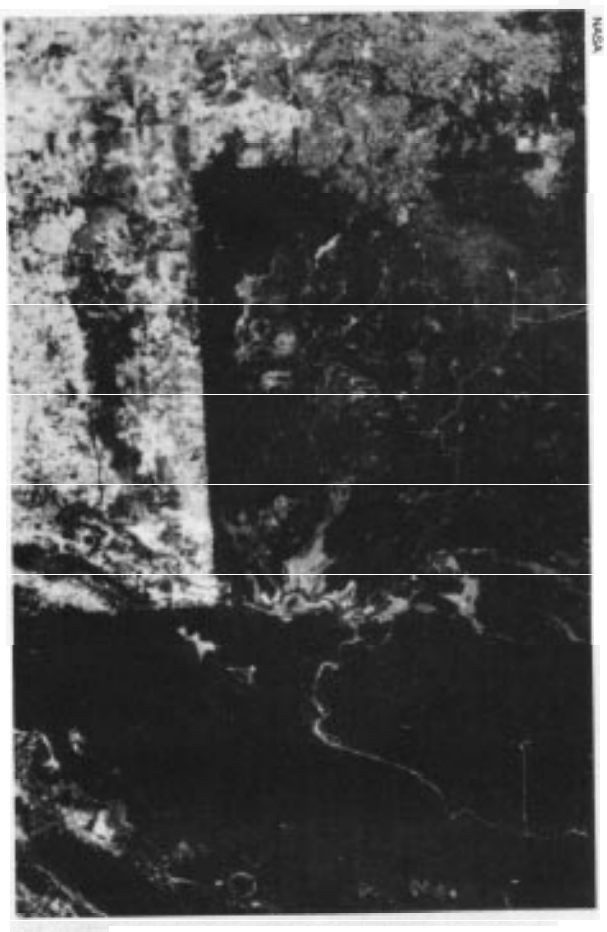
The relative numbers of threatened or endangered species diverge dramatically among the countries examined in this chapter. While mammals represent a fraction of those species, they provide a point of comparison. Canada has the lowest percentage of threatened or endangered mammals (6.2 percent) and France the highest (50.4 percent) (52). In the United States, 10.5 percent of known mammal species are considered threatened or endangered. (See table 6-6 for other countries and species.) In 1994, the number of threatened and endangered species in the United States exceeded 900. Very few studies have measured the loss of habitat due to fragmentation or the edge effect created as a result of agricultural practices. 13

[13] Although some habitats may not be completely converted to farm use (or urban or industrial use), they can be fragmented so greatly that they no longer suit the life-cycle needs of some species. Fragmentation also creates more edge environments (where distinct habitats meet). Although edge environments are normally rich in diversity, the species found in them differ from those found in interior habitats.

As discussed in chapter 4, any modification to land or water resources changes their capacity to sustain plants and animals. Destruction or even modification of habitat by agricultural practices can lead to a reduction in species abundance and/or species diversity. Globally, of species extinctions since 1600, fully 36 percent of those that resulted from known causes are attributed to habitat destruction or modification (86). About one-third of the federally listed threatened or endangered species in the United States are associated with agriculture. (See Chapter 4.) In West Germany, 581 plant species are listed as "declining": 173 because of farmland drainage, 89 because of herbicides, and 56 because of excess nutrients from fertilizers (38).

Converting wetlands to agricultural use is a primary example of disturbing wildlife habitats and damaging natural resources. Until recently, no country had specific policies to protect wetlands. In fact, several had incentives encouraging their "destruction" or their "improvement" to productive uses. With greater scientific understanding of the complexity of wetland ecosystems came an increased appreciation for their functions and, subsequently, greater pressure to protect them. (Aside from acting as habitats for fish, waterfowl, invertebrates, and other wildlife, wetlands absorb urban runoff and flood waters, filter pollutants, improve water quality, and offer recreational opportunities. The value of these wetland functions is often hard to quantify.) However, several governments' agricultural policies, existing simultaneously with wetland protection policies, indirectly encourage the conversion of wetlands to other uses. For example, price supports and program benefits based on cultivated acreage encourage farmers to cultivate on marginal lands as well as wetlands. As a result, before any concerted efforts to protect them were made in any country, a large percentage of the world's wetland areas had been converted to other uses or had been significantly degraded.

Wetlands constitute about 6 percent of global land area. During this century, wetland losses have been very high and wetland quality—in terms of species diversity and certain functions—has diminished. Many authorities classify wetland ecosystems as among the world's most threatened environmental resources (50). The loss of wetlands, as discussed above, can be attributed to the conversion of wetlands to agricultural, industrial, commercial, and residential uses. Degradation of wetland quality can be attributed to air and water pollution, as well as water supply diminution. Between 1980 and 1990, Canada lost an estimated 23 percent of its wetlands; France, 8.5 percent; and West Germany, 22 percent. Although similar information was not available for the United States, New Zealand, or the Netherlands for this time period (52), federal data show that



This aerial Landsat image shows how agricultural expansion can severely effect native habitats. In this area of southern Mexico (left), most of the tropical forest has been cleared *to make way for cropland. By contrast, neighboring Guatemala (right), has retained much of its forests.*

about half of the original wetlands in the conterminous U.S. have been lost, with 80 percent going to agricultural conversions. Indeed, a comprehensive picture of the state of the world's wetlands does not exist, because very few wetlands are assessed or monitored. In the United States (excluding Alaska), for example, only 4 percent of the nation's wetlands have been assessed, and no state is currently operating a comprehensive wetland-monitoring program (77).

Concern about the agricultural impacts on the environment was voiced early in the United Kingdom, with the construction of industrial farm buildings in the 1950s. The dramatic decline of some bird species, which was linked to synthetic pesticides; the loss of different habitat types such as wetlands, hedgerows, and moorlands; and the destruction of nature conservation sites increased public awareness of agriculture's impact on the environment. In 1984, the Nature Conservancy Council published a survey of habitat loss and concluded that since the mid-1950s the nation had lost 95 percent of its lowland herb-rich grasslands, 50 percent of its ancient woodlands, more than 60 percent of its lowland raised bogs, and 33 percent of all its upland grasslands, heaths, and mires (84). In the United Kingdom, wetland loss due solely to agricultural land use and practices was estimated at 150,000 acres per year during the 1970s and early 1980s. A strong, well-organized rural conservation movement developed in Britain, and the whole system of agricultural support, rather than the activities of individual farmers, came under attack as the root cause of undesirable environmental changes.

Since 1949, England has had a provision to designate Sites of Scientific Special Interest (SSSIs). Yet, even though it became evident that changing agricultural and forestry practices were damaging these areas, the SSSI program had no authority to protect them from intensive agricultural activity. In 1981, the government passed the Wildlife and Countryside Act to offer further protection. This act specifically authorized regulation of farming practices such as plowing, draining, and pesticide and fertilizer application to protect these designated areas. Even with this new authority, though, the SSSI program failed to protect valued habitats—in part because it was complex, and because it was administered by the Department of the Environment (DOE) rather than the Ministry of Agriculture, Fisheries, and Food (MAFF). The two agencies did not work together. "A commonly noted shortcoming of countryside management and the conservation regulation of farming practices was that they typically involved the conservation agencies swimming against the tide of agricultural support" (84). Thus, while MAFF was offering financial inducements to farmers to increase productivity and output, DOE was offering incentives for farmers not to increase farming intensity (84). One study of the United Kingdom found that in the early 1980s, some 80 percent of the payments to farmers to refrain from intensive production were essentially subsidies to forgo other subsidies to produce more intensively (15).

Although MAFF was slow to collaborate with other environment agencies or the environmental community on concerns about the impact of farming on the environment, the farming lobby actively engaged in discussions with the environmental community. However, the farm lobby insisted on maintaining agricultural autonomy and stressed the need for informal and voluntary policies to address environmental issues related to agriculture (84).

SSSIs were the precursors to ESAs. In 1984, the United Kingdom proposed modifying the CAP to create ESAs. Within ESAs, farmers would be encouraged to farm using traditional and/or environmentally benign methods. About the same time, MAFF worked to replace grant programs that had been criticized for promoting environmental degradation with a grant program that encouraged planting hedges, repairing traditional walls, planting broad-leaved shelterbelts, and hiring consultants to provide landscaping advice. In 1986, the Agriculture Act required agriculture ministers to balance "the conservation and promotion of the enjoyment of the countryside, the support of a stable and efficient agricultural industry, and the economic and social interests of rural areas" (84).

Many species that are dependent on wide expanses of native forest or grassland habitats cannot thrive in fragmented, farmland habitats. Population trends in many bird species offer clues about the effects of agricultural practices on native wildlife.

The EU Council of Ministers passed the New Structures Directive as Article 19 of Council Regulation 797/85 on Improving the Efficiency of Agricultural Structures. This article allows member states to introduce special national schemes that encourage farming practices favorable to the environment in ESAS. In England in 1985, ESAS became the first "specifically environmental measure to be supported directly from the agricultural budget." In 1987, it was agreed that such schemes could receive up to 25 percent support from the EU budget (84).

In 1987, the first ESAS were established, followed by additional designations in 1988, 1993, and 1994. Farmers in areas designated as ESAS may enter into a voluntary agreement to adopt a certain set of agricultural practices in return for annual compensation. There are usually different options from which the farmer may choose, each associated with a different payment scheme. Management stipulations usually include some combination of restrictions on fertilizer use; prohibitions on the use of pesticides and herbicides; restrictions on livestock densities; restrictions on the installation of drainage schemes or fencing; and requirements to maintain walls, barns, and hedges. Farmer participation has been enthusiastic. By the end of 1987, fully 100,000 hectares of land in England were entered into the program, representing 87 percent of the land targeted for ESA designation. All of the 1988 ESA designations were renewed at the end of five years. In 1993, the United Kingdom had 1.7 million hectares in the program; the proposed area for 1994 is 2.2 million hectares.[14] However, farmers who choose not to participate in the ESA program may still receive subsidies for environmentally damaging practices, reflecting the persistence of conflicting policies (84). Germany, the Netherlands, and France also have ESA schemes.

In the United States, the Conservation Reserve Program (CRP), introduced in the 1985 Farm Bill, was specifically designed to achieve conservation goals by encouraging farmers to withdraw highly erodible or environmentally sensitive lands from crop production for a period of 10 years, in return for annual payments. By 1989, a total of 8 percent of U.S. cropland was enrolled in the program. As a result of the 1990 amendments to the Farm Bill, new rules for CRP operation placed greater emphasis on water quality improvement and public wellhead protection as criteria for accepting land into the program (67).[15] Thirteen percent of the land contracted into the program in March and July of 1991 came from conservation priority area watersheds such as the Chesapeake Bay and Great

[14]The success of the ESA program, compared with the SSS prograrn, has been addributed to several factors: theESAscheme is administered by agricutural officials rather than conservation officials, participation is voluntary, it is less complicated to participate in the program, and it is less restrictive (84).

[15]Protecting aquatic habitat could require more intensive action such ss undoing the structural changes to hydrologic systems that were often put in place to accommodate agricultural needs. (See chapter 5, box 5-l.)

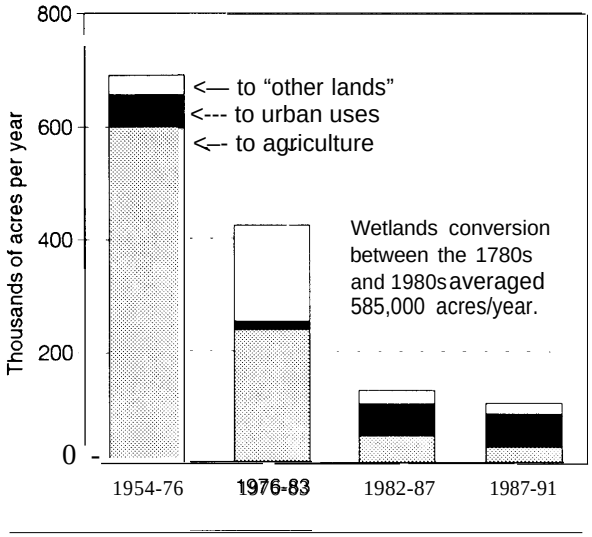
Lakes regions. The 1990 act mandated that a minimum of 16.2 million hectares be enrolled in the CRP, up from the 14 million hectares of 1985(14). Although the CRP was not conceived, nor is it managed, as a program to protect wildlife, it has resulted in improved habitat for wildlife. Generally, the negative effects of modern agriculture on countryside amenities and wildlife habitat are of greater concern in the EU than in the United States and receive a great deal of attention from policymakers in some EU countries (2).

In addition to the CRP, the 1990 act created the Wetlands Reserve Program (WRP), which provides payment and cost-sharing assistance to farmers who agree to return previously farmed or converted wetlands to healthy wetland condition. The WRP is designed to incorporate up to 405,000 hectares of wetlands and protect them by easement for 30 years. The Swampbuster program concentrates on protecting existing wetlands by making farmers who convert wetlands without a permit ineligible for USDA program benefits. The Swampbuster program and a similar program for soil erosion, Sodbuster, were the first steps taken in the United States to move from completely voluntary programs to programs that, although still voluntary, had financial repercussions if not followed.

In the United States, agriculture is no longer the primary cause of wetland losses (figure 6- 1). Yet, of the wetlands lost over the past two centuries, 80 percent has been attributed to the conversion of inland wetlands to agricultural uses. Agricultural conversions of wetlands have slowed since the mid-1980s. However, an estimated 2.11 million hectares of wetlands are still considered prime land for agricultural production.

Between 1950 and 1975, the United States lost wetlands at an estimated rate of 400,000 to 500,000 acres per year. The rate decreased to 250,000 acres per year after 1975. In the mid-1980s, wetlands of the conterminous states

FIGURE 6-1: Conversion of U.S. Wetlands, 1954-1991



SOURCE: Thomas E Dahl, *Wetland Losses in the United States 1780's to 1980's* (Washington DC U S Department of Interior, Fish and Wildlife Service, 1990)

covered approximately 103 million acres (of nearly 2 billion acres) (13). The U.S. Fish and Wildlife Service estimates that 50 percent of the wetlands that existed during colonial times in the lower 48 states are now gone. Roughly 5 percent of the lower 48 states is currently covered by wetlands, and about 45 percent of Alaska is comprised of wetlands.

Roughly 75 percent of remaining U.S. wetlands are located on private land. Increasing loss of these wetlands led the U.S. government to embrace a policy goal of no net loss (NNL) of wetlands in 1989.

U.S. wetlands are not protected by any single federal law or regulation. Several programs at all levels of government play a limited role in protecting wetlands. To influence the behavior of landowners, federal programs have used a combination of direct payments, removal of various

federal subsidies, and a mitigation banking system.[16] State and local programs have concentrated on zoning and land use controls.

Canada contains one-quarter of the world's wetlands. As in the United States, roughly 70 percent of all Canadian wetlands are located on private land, and most of the remaining wetlands on federal land are located in the northern territories. Since 1800, an estimated 20 million hectares—14 percent of Canada's total wetland base—have been drained or lost to other functions. Millions more hectares have been seriously degraded or are at imminent risk. The loss is felt in every region: 65 percent of the Atlantic coastal salt marshes are gone, more than 50 percent of the potholes in the central prairies have been lost, and 70 percent of the Pacific estuary marshes are gone or degraded (26). In Canada, as in the United States, there is no single federal law protecting wetlands. The federal policy on wetland conservation commits all federal departments to a goal of NNL of wetland functions on federal lands and waters, and in areas affected by the implementation of federal programs. In areas where wetland loss has been severe, no further loss of remaining wetlands is allowed.

Six challenges are listed for the NNL policy, including defining NNL, encouraging dialogue among all relevant stakeholders, and spreading the costs of achieving NNL among those who benefit:

> . . .[T]he goal does not imply that individual wetlands will in every instance be untouchable or that the no net loss standard should be applied on an individual permit basis—only that the nation's overall wetlands base reach equilibrium between losses and gains in the short run and increase in the long term. (37)

In the province of Ontario, wetlands are generally depleted in the southern portions of the province. No provincial legislation specifically addresses wetlands or expressly requires their protection. However, the policy generally advocates no loss of wetland function or wetland area of provincially significant wetlands in the Great Lakes-St. Lawrence region, and no loss of wetland function of provincially significant wetlands in the Boreal region. It also encourages the conservation of other wetlands throughout Ontario. Some wetlands are protected under the Fisheries Act, the Canada Wildlife Act, and provincial legislation creating parks and wildlife areas. The Conservation Land Tax Reduction Program and the Conservation Lands Act offer tax rebates to owners of wetlands meeting certain criteria if they leave their wetlands in their natural state (29).

The North American Waterfowl Management Plan (NAWMP), a joint venture between the United States and Canada, was formally initiated in 1986, with the goal of restoring North American waterfowl numbers to their mid-1970s level. One objective of NAWMP is to encourage agricultural producers to set aside land for waterfowl habitat (to maintain potholes and native uplands). However, NAWMP has primarily been concerned with the effects of management on waterfowl populations. "The effects of agricultural prices, government programs, et cetera, on private land-use decisions that affect the availability of wetlands have largely been ignored" (80).

A 1988 study using surveys of farmers in southeastern Saskatchewan indicated that government support programs contribute to wetland depletion in western Canada. The model looked at four price scenarios for wheat. A price of $2.50/bu represents no government support; $3.50/bu represents intermediate support; $4.50/bushel represents the baseline; and $5.50/bushel represents a high level of support. The percentages of wetlands converted under each scenario are 57 percent, 72 percent, 81 percent, and 86 percent, respectively (80). In addition, payments to farmers to maintain

[16] A wetlands mitigation banking program was developed to compensate for unavoidable wetland loss due to development activities such as road construction. The program allows for development as long as plans include off-site creation of wetlands, wetland restoration, or wetland enhancement of other sites. The program is administered primarily under the Clean Water Act and includes the participation of federal agencies, nonprofit organizations, and private entities (64).

waterfowl habitat are higher than they would have to be in the absence of grain-support payments.

Fertilizer Consumption and Environmental Impacts

In addition to soil conservation, one of the first agriculture-related environmental issues to receive broad attention was the nitrate pollution of groundwater and surface water. The primary sources of nitrate pollution include nitrogen fertilizers and animal manure from intensive animal husbandry (72). In humans, high levels of nitrate have caused respiratory failure in infants and may be linked to stomach cancer. Nitrate leaching into ground and surface waters is a principal causes of eutrophication. [17] The effects of these inputs on the environment depend on management practices, soil composition, topography, and climate. In some circumstances, nitrate could leach into groundwater rapidly, and in other circumstances leaching could take decades (12,72,75). Although the United States and the EU have set the consumption level of nitrate for humans at 50 mg/l, surface water quality can be adversely affected by nitrogen at levels as low as 14 mg/l (31,40).

Research has clearly shown agriculture to be the greatest source of nitrate contamination in ground and surface waters, with concentrations increasing three-fold (in forested or prairie areas) to 60-fold (in agricultural areas) (31). Except for the Netherlands, fertilizer consumption per hectare increased in all of the countries examined in this chapter between 1979 and 1991, even though the general trend is toward a decrease in total fertilizer consumption. Japan's consumption of fertilizer has been waning since 1986, when it reached a high of 434 kg/ha. Likewise, Mexico's fertilizer consumption reached a peak in 1987 with 75 kg/ha and has been decreasing since. During the 1980s, fertilizer subsidies were about 40 percent, but Mexico phased them out in 1991 (l). Brazil has decreased consumption steadily since 1987. In 1991, Argentina and Australia consumed the lowest amounts of fertilizer: 6 kg/ha and 27 kg/ha respectively (table 6-7). Argentina's low application rates of fertilizer are partly due to its rich soil. However, soil degradation is one of the country's main agroenvironmental problems and, as it continues, farmers may resort to using more fertilizers. The highest consumption of fertilizer in 1991 was found in New Zealand and the Netherlands, with 934 kg/ha and 581 kg/ha, respectively. The United States consumes 100 kg/ha (table 6-7).

TABLE 6-7: Fertilizer Consumption (Nitrogen, Phosphate, Potash)

Country	Fertilizer consumption (in 1,000s of metric tons) 1979	and 1991	Fertilizer consumption (kg/ha) 1979	and 1991
Argentina	130	166	3	6
Australia	1,214	1,164	25	27
Brazil	3,567	3,148	27	53
Canada	1,808	2,074	18	47
France	5,905	5,683	242	289
Germany [a]				
FR	3,597	2,873	421	247
NL	1,713	1,765	320	
Netherlands	694	561	728	581
U K	2,235	2,450	252	317
Japan	2,344	1,839	365	387
Mexico	1,134	1,559	25	63
New Zealand	546	362	888	934
U.S.	20,941	18,428	80	100

[a]FR=Federal Republic, NL= New Leader

NOTES Japan's fertilizer consumption has been decreasing since 1986 when it reached a high of 434 kg/ha. Fertilizer consumption in Mexico and Brazil has also been decreasing Mexico's fertilizer consumption reached a peak in 1987 with 75 kg/ha and has been decreasing since then Brazil has also decreased consumption steadily since 1987

SOURCES: Food and Agriculture Organization of the United Nations, *Country Tables* (Rome, Italy 1993), Food and Agriculture Organization of the United Nations, *Yearbook, Fertilizer,* vol. 41 (Rome, Italy 1991)

Nitrate Pollution in the EU

Nitrate pollution became a serious concern in the 1980s---especially in the EU, which has one of the world's highest rates of fertilizer use and its high-

[17] Eutrophication is a process through which excess nutrients, principally phosphorous and nitrogen, cause algae blooms, which in turn deplete the dissolved oxygen levels in a body of water.

est livestock densities. In 1980, the EU passed a Drinking Water Directive that set the maximum allowable concentration of nitrate in groundwater at 50 mg/1. It did not legislate any way to enforce this level. The standards were to be met by 1985, but Ireland is the only member state that has done so (72).

In the former West Germany, 5 percent of drinking water tested exceeds the standard, and in France, 2 percent of drinking water tested exceeds the standard. In the Netherlands, the average nitrate concentration found 30 meters below sandy soils is 106 mg/l, more than twice the standard (72). At the EU level, of the total amount of nitrogen applied, 57 percent is residual. Germany, France, and the United Kingdom account for more than 65 percent of the total residual nitrogen of the EU. However, the Netherlands has the highest residual nitrogen levels of all EU countries (These statistics incorporate data from the EC-10[18] only) (72). About 45 percent of the nitrogen from fertilizers applied to the soils in the Netherlands is more than crops need. In addition, nitrogen from manure (principally from pigs) amounts to 1.5 times the amount of nitrogen from fertilizer, giving the Netherlands a total residual nitrogen level of 77 percent of the total amount applied. Part of the problem is that manure is considered something to dispose of, rather than a production input that could offset the use of manufactured fertilizers. To address the problem, the Netherlands is introducing some of the most stringent legislation concerning nitrate contamination among the EU countries.

For the EU as a whole, wheat and course grains account for 45 percent of nitrogen use. For the Netherlands, the nitrate problem stems principally from livestock production (2). Until recently, efforts to control the negative environmental impacts of livestock production focused on regulating the amount and method of manure spreading and improving manure storage. These efforts

Nitrate pollution in surface water and groundwater can result from the leaching of fertilizer or manure used on cropland. Livestock wastes, improperly stored, area significant source of nitrate as well as pathogens that degrade water quality

are not sufficient, because they do nothing to decrease the amount of total manure produced. Policies to restrict livestock numbers and to tax feed manufacturers are now being introduced in the Netherlands (table 6-8) (15).

Various farming practices can be employed to limit the amount of nitrate reaching ground and surface waters. These efforts can be put in three categories: "attempts to match nitrogen availability to plant growth requirements[, which] include plant tissue testing, crediting for the nitrogen content of manure, use of slow release fertilizers, and split applications of nitrogen; practices that physically block nitrate movement such as storing manure in lined lagoons and using vegetative filter strips around field edges; [and] changes in farming practices such as using conservation tillage, planting a postharvest cover crop, and using crop rotations that minimize the need for nitrogen" (48). Generally, governments have used voluntary programs and subsidies to diminish agriculture's negative impact on the environment. Persistent problems have forced some governments to consider other methods.

[18]The EC-10 refers to the original members of the European community, now the European Union: Belgium, Denmark, France, Greece, Germany, Ireland, Italy, Luxembourg, the Netherlands, and the United Kingdom.

TABLE 6-8: Sources of Nitrogen from Manure in Selected EU Countries, 1986 (1,000 Metric Tons)

Country	Dairy	Beef	Pigs	Layers	Broilers	Sheep	Total
Germany	349	651	549	25	102	42	1,717
France	416	1,043	275	33	299	327	2,393
Netherlands	149	176	249	19	143	16	752
U.K.	208	604	217	25	254	511	1,819
Total	1,555	3,408	1,851	142	1,064	1,625	9,645

SOURCE U S Department of Agriculture, Economic Research Service, "The EC Nitrate Directive and Its Potential Effects on EC Livestock Production and Exports of Livestock Products, " by Dale Leuck in *Environmental Policies: Implications for Agricultural Trade,* edited by John Sullivan, USDA/ERS-FAER #252, Washington, DC, June 1994

The EU recognized the limitations of member country programs in meeting the drinking water standard and the discrepancies among countries in implementing the necessary programs to meet the standard. As a result, in 1991, after two years of debate, the EU Council of Environmental Ministers passed the Nitrate Directive. The purpose of the Nitrate Directive is to prevent nitrate levels in water from exceeding the standard of 50 mg/l. Under the directive, regions with excessive amounts of nitrate are classified as vulnerable zones, and farmers residing in those areas must adhere to "codes of good practice." The codes include limits on livestock densities, rules concerning the storage and application of slurry, limits on application rates for chemical fertilizers, rules concerning appropriate fertilizer application, and record keeping (40). Member states may take different approaches to incorporating these principles into practice. Regions outside vulnerable zones are also encouraged to follow the codes of good practice. The minimum standards for the code are set at the EU level, but member countries may set standards that are more strict. Countries with vulnerable zones have until 1995 to establish plans to reduce their nitrate levels to the 50 mg/1 standard or below. They then have four years to implement their plans. Enforcement of the directive relies in large part on citizens groups to make formal complaints if farmers do not comply with the directive. Farmers in member states such as the United Kingdom. Germany, and the Netherlands, which have stronger and more active citizens' groups than other EU members, will be held to strict compliance standards. Farmers in other counties may not be monitored so closely (40).

The Nitrate Directive was designed to place the burden of reducing residual nitrogen on reducing livestock numbers. In the Netherlands, for example, farmers could eliminate residual nitrogen if they reduced their livestock numbers by 65 percent and cut fertilizer use by 28 percent. The necessary livestock reductions are not as drastic for the EU as a whole. Pig production would have to be reduced by 11.7 percent, dairy stock by 7.8 percent, and beef by 4.8 percent (72). The impacts of these reductions on the ability of member countries to remain self-sufficient are shown in table 6-9. The EU as a whole becomes just less than self-sufficient in pork, poultry meat, and eggs. The Netherlands become less than self-sufficient in beef and veal, butter, pork, and poultry meat. The largest drop in the Netherlands comes with a decrease in egg self-sufficiency, from 339 to 119 percent.

Because a significant portion of EU agricultural products is exported, any policy change that affects production could also affect world trade. For the EC- 10, the Nitrate Directive could lead to a decline in beef exports of 50 percent and a decline in dairy exports of 34 to 100 percent. The EU would become a net importer of pork and poultry (table 6-9) (72). Given these projections, the Nitrate Directive should spur research and development as demand grows for new technology to improve the quality, storage, and application of manure. In addition to the Nitrate Directive, other EU policies

TABLE 6-9: Percent Self-Sufficiency: 1991-1992 Average and Estimated Under the Nitrate Directive

Country	Beef/Veal	Butter	Cheese	Dry milk	Pork	Poultry meat	Eggs
Netherlands[a]							
1991-1992	194	174	294	27	257	205	339
Estimated	68	61	103	9	90	72	119
EC-1 O							
1991-1992	110	111	109	132	105	108	102
Estimated	105	102	100	121	93	97	92

[a]For example, in 1991-1992, the Netherlands self-sufficiency rate for cheese was 294 percent, meaning that they met 100 percent of their domestic demand and then could export the remainder Under a fully implemented Nitrate Directive the Netherlands would still meet their domestic demand for cheese, but would have much less available for export, 3 percent.

SOURCE: U.S. Department of Agriculture, Economic Research Service, "The EC Nitrate Directive and its Potential Effects on EC Livestock Production and Exports of Livestock Products, " by Dale Leuck in *Environmental Policies Implications for Agricultural Trade,* edited by John Sullivan, USDA/ERS-FAER #252, Washington, DC, June 1994

that were not implemented specifically for environmental reasons—such as a new superlevy equal to 115 percent of the target price for milk produced beyond a quota----could help to decrease nitrate levels.

The Netherlands

Dutch farmers, who export about 65 percent of their total output, generally use more chemical fertilizers than farmers in any other country, In 1991, Dutch farmers used 581 kg/ha of chemical fertilizer (18). Such intensive farming has caused environmental problems, most notably nitrate contamination of groundwater. The government realized in the early 1980s that the problem could be addressed only by requiring significant changes in the agricultural sector. The current policy holds that export expansion cannot interfere with national environmental priorities.

Well before the Nitrate Directive was passed, the Netherlands was struggling with the environmental problems posed by excessive manure. In 1986, the government implemented a three-phase program to address the nitrate issue. The first phase (1987-1990) aimed at stabilizing the problem by setting standards for the maximum amount of manure that could be applied per hectare. The initial standards were set high enough that the current level of manure could be disposed of, but set strict regulations on the expansion of existing farms or the establishment of new farms. The second phase (1991-1994) gradually tightened the maximum application standards. Phase three (1995-2000) further tightens the standards to balance application of fertilizer and manure against what the Dutch environment can absorb (46). Farmers are initially allowed to meet fertilizer reduction goals in any way they choose. However, if they have not met the goals by the specified time, they are subject to a tax on input use (68). In addition, 200,000 hectares of land have been retired in a program analogous to the CRP in the United States. An estimated 90 percent of Dutch farmers comply with the regulations of these programs.

Through the Fertilizer Act, the government has set up a national manure bank that allows farmers who have too much manure to transport it to other parts of the country that are below the manure standard. Large-scale manure-processing plants are also being developed to process manure in pelted form for export. In 1988, the Netherlands established a tax on livestock feed manufacturers. The revenue from the tax goes toward financing education and research on manure disposal (15).

Germany

Germany's Council of Environmental Advisors considers nitrate contamination of the groundwater one of the most serious environmental problems attributed to agriculture although, as in other

countries, the problem remains regional. In 1987, a full 46 percent of the nitrate problem stemmed from agricultural practices. In 1983, a total of 800 out of the 6,000 water supply facilities exceeded the 50 mg/l nitrate level, up from 129 in 1979. Until recently, nitrate pollution was addressed at the supply end: aquifers were closed, new boreholes were drilled, and polluted water was mixed with clean water. Now, the chief policy objective is to reduce nitrate pollution from agricultural sources, although these measures are not yet well implemented (58).

Under a 1986 drinking water ordinance and the Act on Water Resource Management, local authorities are to determine which water collection areas need protection. Standards for agricultural practices can be set within these areas. If farmers have to employ practices more stringent than those stipulated in the act in order to meet its standards, and if, consequently, their incomes drop as a result of lower yields or higher production costs, the act provides compensation for them. Designated protected areas range from between 3 and 40 percent of a region. Germany's Fertilizer Act, instituted in 1989, contains an amendment that allows fertilizer use only if "the code of good agricultural practice is followed," which means that fertilizer application must be determined by considering the nutrient requirement of crops, the nutrient content of the soil, and the productivity of the soil. The Act to Support Rural Farming prescribes livestock densities. If these are exceeded, farmers may lose certain subsidies. The government also plans to enact a Fertilizer Application Ordinance, which will fulfill the requirements of the EU Nitrate Directive and further define "good agricultural practices."

Nitrate Pollution in the United States

A national survey of rural drinking water wells in the United States found that 3 to 6 percent of them contained nitrate concentrations above the drinking water standard of 1Omg/l established by the U.S. Environmental Protection Agency (see footnote 11). Elevated nitrogen levels have been detected in some groundwater or surface water of all 50 states (31,48), although not all of these cases exceeded EPA standards. Still, in Nebraska, an estimated 20 percent of drinking water wells exceed the standard, and in southeastern Pennsylvania 28 percent exceed the standard (48). Cases of local or regional nitrate problems are not uncommon across the United States.

Surface water draining from areas of intensive cropland or livestock operations regularly contains elevated nitrate levels. In the San Joaquin Valley, one of the most intensive agricultural areas in the country, nitrate levels regularly exceed 1Omg/1 (47). Groundwater under agricultural lands also tends to exceed this nitrate standard nearly 3 times more often then water beneath any other land use (see chapter 4). Besides posing a problem for drinking water, nitrate carried in surface water flows promotes eutrophication in rivers, lakes and estuaries, thus impairing their ability to serve as aquatic habitat (see chapter 4).

The United States does not have a basic policy on nitrate pollution equivalent to the Nitrate Directive of the EU. Rather, the nitrate problem is addressed, or could potentially be addressed, in sections of the Safe Drinking Water Act (SDWA), the Clean Water Act (CWA), the Toxic Substances Control Act (TSCA), and the Coastal Zone Management Act (CZMA). However, the provisions in these acts for addressing the nitrate problem are mostly voluntary, and there is no federal implementation of nitrate policy.

Under the CZMA Reauthorization Amendments of 1990, the 29 states and territories with federally approved coastal zone management programs are required to develop enforceable policies and mechanisms to implement nonpoint source pollution control programs. Six nonpoint source management measures address a range of related issues: erosion and sediment control, small and large confined animal facilities, pesticide management, grazing management, irrigation management, and nutrient (including nitrate) management. The nutrient management measure requires all farms in the coastal zone to:

> . . . develop, implement, and periodically update a nutrient management plan to: 1) apply nu-

trients at rates necessary to achieve realistic crop yields, 2) improve the timing of nutrient application, and 3) use agronomic crop production technology to increase nutrient use efficiency (76).

States are required to develop their plans for EPA and NOAA (National Oceanic and Atmospheric Administration) approval by July 1995. After approval, they have three years to fully implement their plans. If states choose not to develop plans, they will forgo federal funding under section 319 of the CWA, which establishes a national program to control nonpoint sources of pollution,[19] and section 306 of the CZMA. Some states, such as Texas, may choose to incur the loss of federal funding. Others, like Pennsylvania, have redefined their coastal zone boundaries to exclude areas with high manure supplies.[20] Because there is no federal implementation of these nutrient management measures, there is no further recourse to require states to develop meaningful plans.

USDA also coordinates voluntary and educational programs on preventing nutrient problems with cost-share funding provided by the Agricultural Conservation Program (ACP) run by the Consolidated Farm Services Agency (CFSA) and the educational programs of the Natural Resources Conservation Service (NRCS). These programs are discussed in chapter 4.

Air Quality

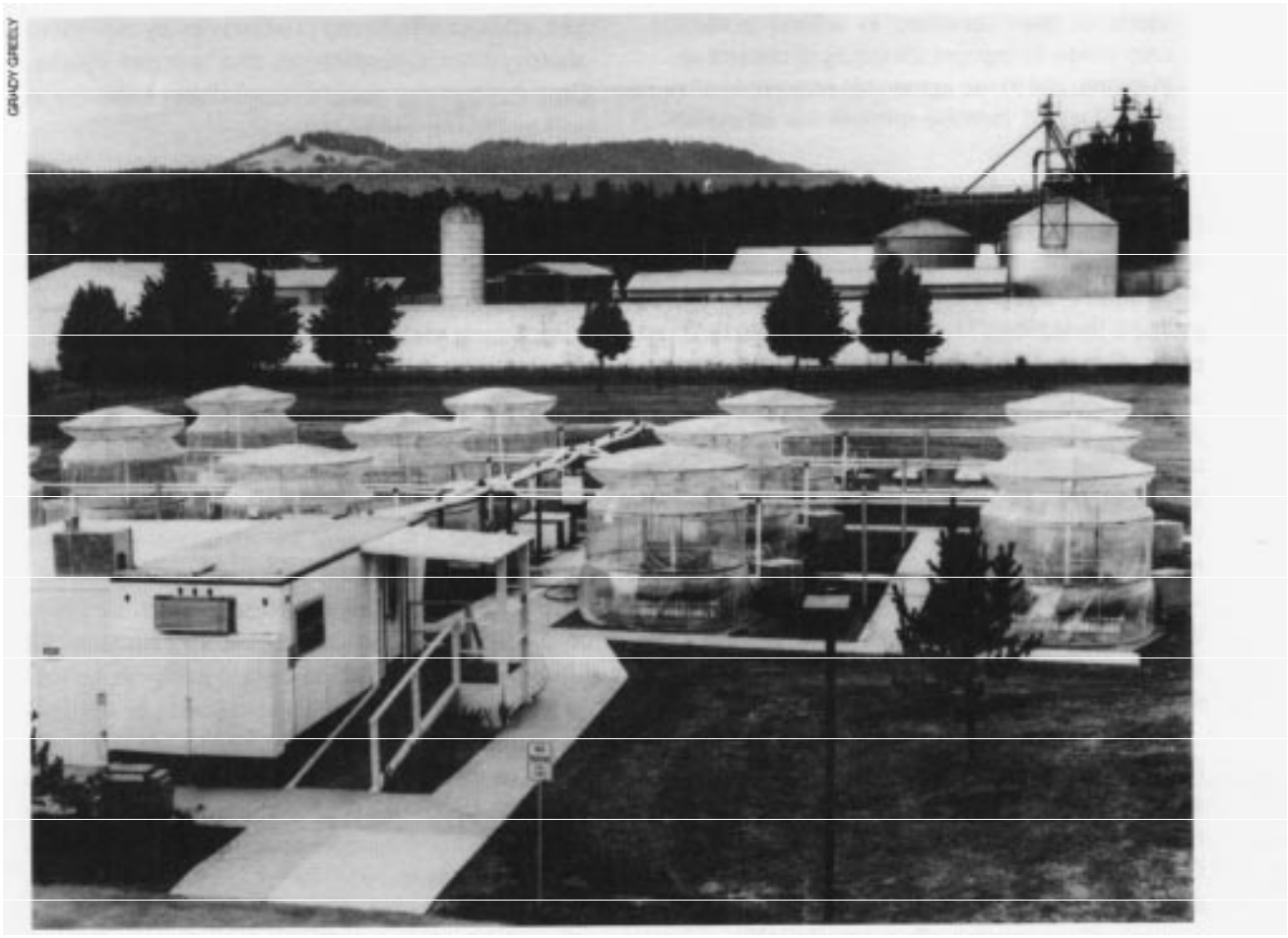
In addition to acting as a generator of environmental damage, agriculture is also the recipient of damage from other sources. External environmental impacts on agriculture include natural disasters such as floods and droughts; conversion of farmland to urban uses; global climate change; and air, water, and soil pollution from urban and industrial sources (55). This section singles out air pollution and its impact on agriculture.

Pollution generated in urban centers can be transported to agricultural areas through wind and rain, and can affect crop productivity by inhibiting photosynthesis, respiration, and nutrient uptake. Crop damage can occur through direct exposure to pollutants or from the indirect effects of pollution. One study looking at the regions of eastern North America, Europe, and eastern China and Japan found that 9 to 35 percent of the world's food crops are exposed to ozone concentrations (i.e., increased ozone levels) above a threshold shown to reduce crop yields by 5 to 10 percent. The study suggests that the current loss of the world's cereal and other crop yields due to ozone is 3 percent (11). Another study of the eastern United States estimated that a 10-percent reduction in ozone levels would result in yield increases of 4.1 percent for corn and 3.0 percent for soybeans, and that a 10-percent reduction would result in a yield increase of 3.4 percent for corn (82,83). In 1984, crop damage due to ozone cost an estimated $2 billion (65). "On a national scale in North America and western Europe, current losses of agricultural production due to air pollutants are small relative to other factors, but local impacts on sensitive crops may be substantial" (7). Yield losses averaged over the state of California from ambient ozone in 1984, for example, were an estimated 20 to 30 percent for sensitive crops such as grape, cotton, citrus fruits, beans, and onions. In the Los Angeles basin, where ozone concentrations are among the highest in the world, production of many sensitive crops has been abandoned (7).

In the United States, air quality standards are determined and regulated through the Clean Air Act of 1970 (amended in 1977 and 1990). The U.S. approach to regulation is generally more centralized than that of Canada, France, the Netherlands or Japan, for example, but less centralized than that of Taiwan or China. The federal government is responsible for setting the minimal, binding national ambient air quality standards (NAAQS), approving and overseeing state programs, and providing financial and technical as-

[19] Personal communications, Roberta Perry, EPA, Oct. 26, 1994 and Andy Manale, EPA, Dec. 7, 1994.

[20] Personal communication, Andy Manale, EPA, Dec. 7, 1994.



Poor air quality can reduce crop productivity Here, federal researchers study how exposure to ozone effects various *crops.*

sistance to states. The states are responsible for developing and implementing programs that will result in compliance with federal standards. The Clean Air Act of 1990 broadens the scope of regulations pertaining to ozone and particulate to include smaller sources that were previously exempt. In addition to NAAQS, the act provides for the Prevention of Significant Deterioration (PSD) Program, which aims to maintain air quality in areas already below the NAAQS.

Although the Clean Air Act of the United States has brought notable improvements in air quality, many areas do not yet comply with the act. In 1994, a total of 92 areas (more than 400 counties) violated the ozone standard, even though ambient ozone levels declined by 14 percent between 1980 and 1989. And although ambient concentrations of $S0_2$ decreased by 24 percent between 1980 and 1989, a total of 44 counties were classified as "nonattainment" areas for $S0_2$ in 1994 (65,78). NOx emissions[21] increased by 8 percent between 1970 and 1989, largely due to increased fuel consumption. NOx emissions have also increased in several other countries, including Canada, Japan, and Germany (table 6-10).

21 Nitrogen oxide, NO, and nitrogen dioxide, NO_2, are collectively referred to as NOx. Likewise, SOx refers to the sulfur oxides, including sulfur dioxide or $S0_2$.

TABLE 6-10: Trends in NO_2, SO_2, and Suspended Particulate Matter Concentrations in Selected Cities

Trends of $N0_2$ Concentration in Selected Cities

Nation	City	1980	1984	1985	1986	1987	1988
Canada	Montreal	O 027	0,022	0.021	0.020	0.023	0.024
	Vancouver	NA	0.024	0022	0023	0.021	0023
U.S.	New York	0.032	0.032	0.031	0.030	0.033	0.033
	Los Angeles	0.047	0,043	0044	0.044	0.037	0039
France	Pans	NA	NA	NA	NA	NA	NA
Germany	Berlin	0.017	0,019	0.020	0019	0022	0022
	Frankfurt	0026	0023	0.021	0022	0025	0.026
Netherlands	Amsterdam	0.019	0.020	0022	0025	0028	0028
U.K.	London	0031	0,040	0.031	0034	0.037	0.033
Japan	Tokyo	0034	0031	0.030	0030	0033	0.033
	Kawasaki	0027	0.033	0031	0033	0033	0033

Trends of Suspended Particulate Matter in Selected Cities

Nation	City	1980	1984	1985	1986	1987	1988
Canada	Montreal	0.014	0.006	0.007	0.006	0.005	0005
U.S.	New York	0.013	0.014	0.013	0.012	0.012	0011
	Los Angeles	0.008	0.005	0.004	0.004	0.004	0004
France	Pans	0.031	0.019	0.018	0.017	0.016	0012
Germany	Berlin	0.032	0.023	0.023	0.023	0.026	0018
Netherlands	Amsterdam	0.009	0.007	0.006	0.005	0.005	0005
U.K.	London	0.025	0.017	0.015	0.016	0.014	0.014
Japan	Tokyo	0.018	0.010	0.009	0.009	0.009	0007
	Kawasaki	0.014	0.011	0.010	0.009	0.010	0010

Trends of $S0_2$ Concentration in Selected Cities

Nation	City	1980	1984	1985	1986	1987	1988
Canada	Montreal	0.082	0,057	0.048	0051	0053	0045
	Vancouver	0068	0035	0.043	0040	0044	0037
U.S.	New York	0056	0,050	0050	0046	0048	0.050
	Los Angeles	0090	0085	0.084	0078	0.081	0.084
France	Paris	0.051	0,047	0049	0046	0046	0029
Germany	Berlin	0098	0120	0124	0.125	0095	0090
	Frankfurt	0.073	0.034	0.068	0058	0071	0061
Netherlands	Amsterdam	0066	0.065	0.063	0053	0045	0044
U.K.	London	0.021	0.018	0.015	0015	0.016	0019
Japan	Tokyo	0.048	0,052	0.053	0058	0.059	0.053
	Kawasaki	NA	0.046	0,042	0.047	0051	0047

NOTE: The readers should be cautious when interpreting this table, especially because of large differences in the number of monitoring sites and method of monitoring among countries A comparison between two or more cities is not advisable, a comparison of trends is preferable

NA=Not Available.

SOURCE: Government of Japan, Environment Agency, *Quality of the Environment in Japan, 1992,* Organization for Economic Cooperation and Development, *Environmental Data Compendium 1991* (Paris, France, 1991)

Canada's air quality is similar to that of the United States, but its approach to regulation is much more decentralized. Under the Canadian Clean Air Act of 1971, the federal government has the authority to set nonbinding guidelines. Binding air quality standards and the regulations necessary to achieve them are generally set by the provincial governments (one exception is that the federal government sets standards for automobile emissions from new vehicles). Although levels of SO_2 and total suspended particulates (TSPs) have been decreasing, more than half of all Canadians are exposed to unhealthy amounts of smog, ozone, NOx, and volatile organic compounds (VOCs) (25,27). Between 1979 and 1987, the amount of ozone in Canadian air increased by 7 percent.

Japan has invested heavily in industrial stationary source pollution control technology and has established one of the most sophisticated air pollution monitoring networks in the world, partly as a result of serious pollution problems in the 1960s and increased public outcry.[22] Compared with other OECD countries, Japan now has the lowest per-capita and per-unit GDP emission levels of SOx (see footnote 21) and NOx. Japan established environmental quality standards (EQS) in 1967 under the Basic Law for Environmental Pollution for SO_2, NO_2, CO, PM-10, and photochemical oxidants.

Nonetheless, air quality problems in Japan persist. NOx emissions decreased 21 percent between 1970 and 1989, largely due to improvements in combustion technology and the introduction of catalytic converters on motor vehicles. However, because the transportation sector continued to grow, and the EQS for NO_2 were relaxed in 1978, NOx emissions have increased since 1985.

The European Union has established air quality directives for SO_2, NO_2, suspended particulates, and lead. Member states must comply with pollutant levels deemed generally acceptable, and must strive to achieve the more stringent guidelines. Member states must also draw up improvement plans for areas that exceed the acceptable levels. The directive addressing SO_2 incorporates a "standstill principle" similar to that of the PSD in the United States, under which air quality is not allowed to deteriorate significantly even in areas well below the maximum allowable limits for these pollutants (30).

Germany, France, and the Netherlands are generally in formal compliance with the air quality directives of the European Union. The United Kingdom has a a good legal record but still needs to address specific issues that remain unresolved, such as the exemption of Northern Ireland from many of the regulations, the sulfur content of gas and oil, and vehicle emissions. The Netherlands has one of the EU's best records for implementing the directives; Germany, France, and the United Kingdom have experienced relatively few problems. The directives addressing vehicle emissions and emissions from industrial plants have been especially difficult for member states to comply with (30).

Several countries participate in both bilateral and multinational agreements. For example, the United Nations Economic Commission for Europe Long-Range Transport of Air Pollutants addresses NOx and will address SO_2 and VOC; the U.S.-Canada Air Quality Agreement, signed in 1991, commits both countries to specific targets and timetables for reducing acid deposition precursors; a joint communiqué signed by the United States and Mexico in 1990 calls for a plan to reinforce border cooperation on a range of environmental issues, including air quality (65). Table 6-11 shows how various countries' air quality standards compare with those of the World Health Organization (WHO). National U.S. standards are

[22] Environmental awareness grew in Japan during the late 1950s and early 1960s, when several widespread diseases—Minimata disease, Itaiitai disease, and Yokkaichi asthma—were associated with the manufacture of the chemical acetaldehyde, the mining of cadmium, and the operation of petrochemical plants. The Japanese government eventually instituted one of the world's most advanced compensatory programs for the victims of pollution. The program was abolished in 1988 (8).

TABLE 6-11: Comparison of Country Air Quality Standards to WHO Air Quality Standards

	NOS (1hr)	SO2 (24hr)	Ozone (1hr)
Countries with Air Quality Standards More Stringent than WHO Standards	Brazil EU Japan[a]	Japan[b]	Brazil Japan U.S. (CA)
Countries with Air Quality Standards Less Stringent than WHO Standards	Argentina Taiwan U.S. (CA)	Taiwan Brazil EU Us. U.S. (CA)	Argentina Us.

[a]24-hour standard used
[b]1-hour standard used

SOURCE: UNEP/WHO, *Earthwatch Global Environment Monitoring System Urban Air Pollution* in *Megacities of the World,* Blackwell Reference, 1992

set below WHO standards for $S0_2$ and ozone, although California's standard for ozone is set above the WHO standard. Only Japan air quality standards are set higher than the WHO standards for $N0_2$, $S0_2$, and ozone.

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