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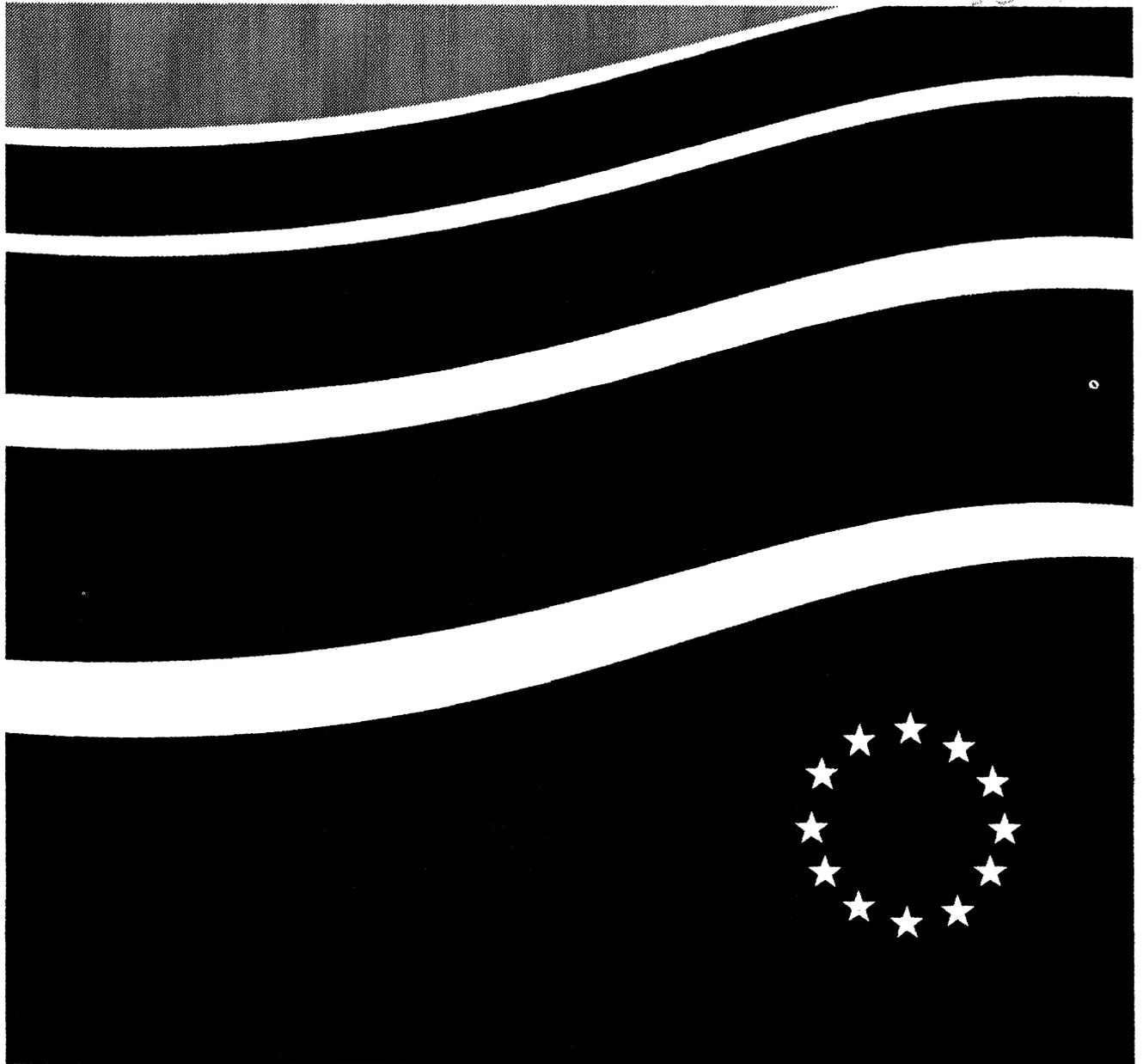
Economic  
Research  
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Agriculture  
Information  
Bulletin  
Number 708

# Agriculture and the Environment in the European Union

Philip I. Szmedra

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**Agriculture and the Environment in the European Union.** By Philip I. Szmedra, Natural Resources and Environment Division, Economic Research Service, United States Department of Agriculture. Agriculture Information Bulletin 708.

## **Abstract**

Agricultural production in the European Union (EU) has increased dramatically since the early 1950's, but at a considerable environmental cost. Artificially high commodity prices maintained through the Common Agricultural Policy (CAP) have encouraged heavy investment in improved technologies and reinforced intensive use of such agricultural inputs as fertilizers and pesticides. Environmental degradation has included nitrate pollution of drinking water and loss of wildlife species. However, major reform of the CAP in May 1992 included direct payments to farmers, increased measures to limit production, and programs specifically designed to produce environmental benefits. Input use in U.S. agriculture is only a fraction of that in Europe and arable land area much more extensive. In the future, American farmers will face less severe tradeoffs between productivity and environmental preservation than their EU counterparts.

Keywords: European Union, environment, pesticide use, fertilizer use, agricultural policy, Common Agricultural Policy reform

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## Summary

Agricultural production in the European Union (EU, the successor to the European Community) has increased dramatically since the early 1950's, but at a considerable environmental cost. Artificially high commodity prices maintained through the Common Agricultural Policy (CAP) have encouraged heavy investment in improved technologies and reinforced intense use of such agricultural inputs as fertilizers and pesticides. Resulting environmental degradation has included nitrate pollution of drinking water and loss of wildlife species. However, major reform of the CAP in May 1992 to address these problems included direct payments to farmers, increased measures to limit production, and other programs specifically designed to produce environmental benefits. Input use in U.S. agriculture is only a fraction of that in Europe and arable land area much more extensive. In the future, American farmers will face less severe tradeoffs between productivity and environmental preservation than their EU counterparts.

Trends in chemical fertilizer and pesticide use in the EU reflect two distinct and opposing influences. First, high support prices established and maintained under the CAP have provided incentives for farmers to use inputs heavily. Second, input use has declined in regions with recognized environmental problems. Between 1985 and 1989, nitrogen fertilizer use decreased by 13 percent in the Netherlands, 12 percent in Italy, and 6 percent in the United Kingdom. In Denmark, Germany, and Belgium, nitrogen fertilizer use remained essentially unchanged, but farmers in France, Ireland, Portugal, and Spain increased their use of nitrogen fertilizers by 10 to 15 percent.

France is the largest market for agrichemicals within Europe, annually purchasing about a third of the compounds sold in the Western European market. The growing influence of environmental action groups and the recent discovery of nitrates in drinking water have heightened awareness of the harmful effects of input-intensive agriculture.

The countries in the Mediterranean region are generally less developed than their northern neighbors and characteristically express a greater concern for "pulling even" economically rather than controlling or cleaning up pollution created by agricultural productivity increases and industrial expansion. Maintaining small, marginally profitable farms is a key concern of agricultural policy in the south.

CAP expenditures have had some positive results. The EU's balance of trade has been markedly aided by agricultural exports. EU farmers have adopted labor-saving technologies. Agricultural sector real incomes have grown rapidly and now appear more stable than U.S. farm incomes. Yields for field crops have been exceptionally high because of heavy input use.

However, the CAP has directly or indirectly contributed to unwanted effects. EU food prices are higher than in world markets. Some commodities continue to be produced at surplus levels. Heavily subsidized agricultural exports policies have led to accusations that the EU is guilty of unfair trade practices. CAP expenditures for surplus food commodities in the late 1980's were equivalent to 49 percent of the final value of agricultural output in the EC compared with 22 percent in the United States. And, high input-use levels have created or contributed to environmental degradation.

# Agriculture and the Environment in the European Union

Philip I. Szmedra

## Introduction

Agricultural production in the European Union (EU, formerly the European Community, EC) has increased dramatically since the early 1950's, though at a considerable environmental cost. Productivity increases have come as a result of the application of improved production technologies including the conversion to mechanization and the use of new seed varieties combined with intensive fertilizer and pesticide applications. Commodity pricing policies instituted through the Common Agricultural Policy (CAP) have maintained artificially high prices, which have encouraged heavy investment in improved technologies and subsequent intensification of input use.

Agricultural self-sufficiency grew from 91 percent in the EC6 (Belgium, France, Germany, Italy, Luxembourg, and the Netherlands) in 1958 to greater than 120 percent in cereals and sugar production in the EC12 (the EC6 plus Denmark, Greece, Ireland, Portugal, Spain, and the United Kingdom) in 1990 (Statistical Office of the European Communities). Between 1983 and 1990, the EC's share of world agricultural exports increased from 11.5 to 14 percent, aided considerably by export subsidies (table 1). Total and per capita agricultural production growth rates for the EC12 have, in most cases, been consistently positive since the 1960's (table 2).

Input use contributing to increased production has grown significantly. Fertilizer use increased 550 percent in the EC's important agricultural production nations (France, Germany, the United Kingdom, Italy, and the Netherlands) between 1951 and 1989 while pesticide use increased 20 to 125 percent between 1975 and 1988 (OECD, 1989). Nitrogenous fertilizer use in Germany in 1990 was estimated at 42 tons per square mile of arable land. In France, the figure was 30 tons. By comparison, in the United States, 7.4 tons of nitrogen was applied on average to each square mile of arable land (table 3, fig. 1). In many regions of the EU, water quality has declined. Heavy

fertilizer use contributes to water pollution problems by the leaching of nitrates, phosphates, and heavy metals through susceptible soils.

Native forests and grassland have been converted to agricultural uses. Since 1945, England and Wales have lost 98 percent of old pasture, 70 percent of original peatlands, 58 percent of ancient forest, and 40 percent of heathland (Gardner, 1987).

Loss of species diversity is also a concern. Fifty-two percent of mammalian species and 40 percent of bird species in France are considered threatened. In Germany, the respective figures are 47 percent and 32 percent. By comparison, in the United States, 11 percent of mammal and 7 percent of bird species are considered threatened (table 4, fig. 2). Industrial pollution, the destruction of wetlands and native habitat through the expansion of extractive industries, urban sprawl, and agricultural pollutants have all contributed to species loss. But the problem is magnified in regions using intensive agricultural practices.

What emerges is a picture of a rich agricultural resource that only recently has been confronted with the question of sustainability: of the resource base; of the health and safety of consumers, farmworkers, and wildlife; and of the EU's strong position in world trade of agricultural products. This bulletin examines some of the agriculture-related environmental problems confronting the European Union. It describes the recent trends of agrichemical use in the EU and regional similarities and differences in environmental concern. It also examines the Common Agricultural Policy (CAP) and EU policies in general as these relate to agriculture-attributed environmental problems, to policy proposals that have been implemented or offered by the EU and its member states, and to possible implications for U.S. agriculture and agricultural policy.

**Table 1--World exports and EC external trade for all products and agricultural products**

Item	1983	1984	1985	1986	1987	1988	1989	1990
Nominal billion U.S. dollars								
World exports:								
All products	1,482	1,575	1,580	1,712	1,966	2,212	2,386	2,644
Agricultural products	218	230	217	229	257	295	310	323
European Union exports:								
All products	270	279	289	339	392	429	455	529
Agricultural products	25	26	26	29	33	36	40	45
Percent								
European Union agricultural exports as a share of world agricultural exports	11.5	11	12	13	13	12	13	14

Source: Office of the European Communities, 1990.

**Table 2--Average annual growth rates of total and per capita agricultural production**

Country	Total agricultural production			Per capita agricultural production		
	1961-70	1970-80	1980-89	1961-70	1970-80	1980-89
Percent						
European Community	2.0	1.9	0.8	1.2	1.4	0.6
Belgium/Luxembourg	2.0	.2	1.5	1.5	0	1.4
Denmark	0	1.7	1.4	-.6	1.3	1.4
France	1.7	1.5	.6	.7	.9	.2
Germany	2.2	1.1	.9	1.3	1.0	1.1
Greece	2.5	3.0	0	2.0	2.0	-.5
Ireland	1.6	3.2	1.0	1.2	1.8	-.3
Italy	2.4	1.6	.1	1.8	1.0	0
Netherlands	3.1	3.2	1.9	1.8	2.3	1.5
Portugal	1.3	0	.3	1.1	-.8	-.2
Spain	2.6	3.4	1.9	1.5	2.3	1.3
United Kingdom	1.5	1.6	.7	1.0	1.5	.6

Source: Organization for Economic Cooperation and Development, Environmental Data Compendium, Paris, France 1989.

**Table 3--Nitrogenous fertilizer use on arable land**

Country	1989	1990	1991
Tons/square mile			
United States	7.1	7.4	7.6
France	30.2	29.8	21.0
Germany	42.9	41.9	34.0
Italy	21.6	21.9	13.0
United Kingdom	23.9	21.9	34.0
World average	4.7	4.8	8.1

Sources: For United States, Taylor, 1994. All other data from Organization for Economic Cooperation and Development, State of the Environment, Paris, France, 1991.

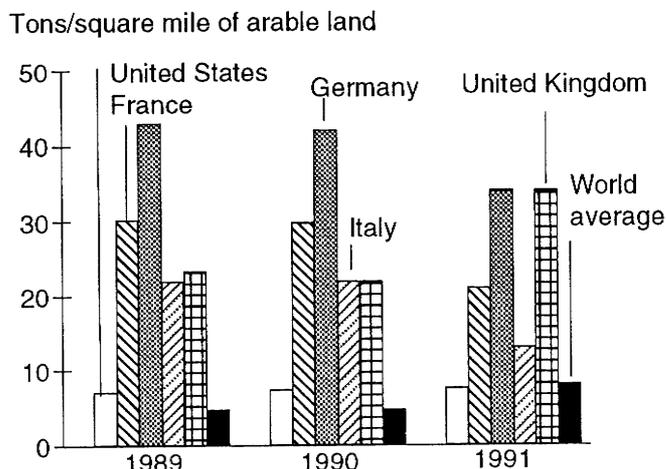
## Agricultural Chemical Use in the European Union

Agricultural chemicals play two essential roles in modern agriculture: they increase yield and quality by maintaining and improving of soil fertility, and they reduce or eliminate serious pre- and postharvest losses due to pest and disease attack. Agrichemicals include chemical fertilizers (nitrogen, phosphorus, and potassium) and pesticides (insecticides, fungicides, rodenticides, herbicides, plant growth regulators, soil and post-harvest fumigants, and like materials).

Figure 1

### Nitrogenous fertilizer use

Increased environmental awareness in some European countries is helping lower nitrogenous fertilizer use



Sources: For United States, Taylor, 1994. All other data from Organization for Economic Cooperation and Development, *State of the Environment*, Paris, France, 1991.

**Table 4--Threatened species in selected countries, 1991**

Country	Share endangered	
	Mammals	Birds
	Percent	
United States	10.5	7.2
France	52.2	39.8
Germany	46.8	32.1
Italy	13.4	14.3
United Kingdom	31.2	15.0

Source: Organization for Economic Cooperation and Development, *Environmental Indicators*, Paris, France, 1991.

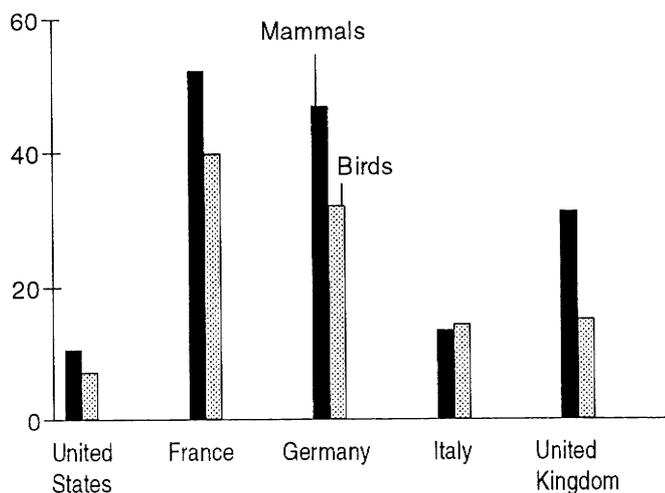
Western Europe is the largest agricultural market in the world with a market share of 31 percent in 1991 (*AgraEurope*, Nov. 6, 1992). Nitrogen fertilizer has been the single most important contributor to productivity increases in Western Europe since World War II. Between 1951 and 1980, the consumption of nitrogen increased 250 percent in Belgium and the Netherlands, and it grew 500 percent in West Germany and Italy, 700 percent in France, and 600 percent in the United Kingdom (table 5, fig. 3).

Beginning in 1985, however, nitrogen fertilizer use reached a plateau, and in some nations the gross volume of chemical fertilizer applied actually decreased. Between 1985 and 1989, the quantity of nitrogen used in the Netherlands decreased 13 percent, 12 percent in Italy, and 6 percent in the United Kingdom. In Denmark, Germany, and Belgium use remained

Figure 2

### Threatened species

Intensive agricultural chemical use has been especially harmful to wildlife in Europe  
Percent of known species



Source: Organization for Economic Cooperation and Development, *Environmental Indicators*, Paris, France, 1991.

essentially unchanged. In France, Ireland, Portugal, and Spain, nitrogen use increased 10 to 25 percent. These trends partially reflect the combined influences of changing cropping practices and the nutritive needs of specific crops. Perhaps more important are the specific commodity price incentives or disincentives through support price programs or intervention purchases by the EU which change the relative profitability of specific crops and the related input requirements. Decreased use in the Netherlands and the United Kingdom may also reflect the effects of recent regulatory measures to limit nutritive overuse to protect against ground and surface water pollution.

Trends in pesticide use reflect two distinctive and opposing influences. First, high support prices established and maintained under the CAP have provided incentives for farmers to use heavy levels of inputs. Second, input use rates registered a net decrease during the 1980's in regions where environmental problems had become obvious. For instance, in France where environmental problems associated with agricultural production practices are not perceived as being acute, the use of insecticides increased by 38 percent between 1980 and 1988 (table 6), of fungicides by 26 percent (table 7), and of herbicides by 11 percent (table 8). By comparison, fungicide use in Denmark, where there exists substantial concern, increased from 665 tons in 1980 to 2,406 tons by 1985 but decreased to 1,180 tons by 1988. Herbicide use increased from 3,876 tons in 1980 to 5,168 tons in 1982 and fell back to 3,993 tons by 1988. In the former West Germany, herbicide use de-

**Table 5--Nitrogen fertilizer use**

Country	1951	1970	1975	1980	1985	1986	1987	1988	1989
	1,000 tons								
Belgium/ Luxembourg	75	178	182	194	195	199	199	196	195
Denmark	-	289	339	374	382	381	367	377	386
Germany	460	1,642	1,906	2,303	2,286	2,287	2,375	2,413	2,254
Greece	-	201	275	333	450	432	384	409	426
Spain	-	578	722	902	962	1,063	1,148	1,168	1,109
France	295	1,453	1,708	2,147	2,408	2,568	2,557	2,604	2,660
Ireland	-	87	153	275	314	343	340	349	349
Italy	200	595	724	1,006	1,055	1,011	1,047	925	925
Netherlands	190	405	453	483	500	504	458	435	435
Portugal	-	77	141	137	137	150	153	157	157
United Kingdom	210	801	1,045	1,240	1,568	1,671	1,525	1,462	1,462

- = Not available.

Source: Organization for Economic Cooperation and Development, Environmental Data Compendium, Paris.

**Table 6--Insecticide use trends**

Country	1975	1980	1981	1982	1983	1984	1985	1986	1987	1988
	Tons ----- Index (1975=100) -----									
Denmark	349	91	-	127	135	126	125	95	123	125
Germany	1,648	142	146	118	131	149	95	88	74	-
France	3,800	126	134	145	129	145	166	190	171	174
Italy	27,064	121	116	110	123	-	135	124	122	135
Netherlands	455	-	-	-	-	144	139	123	109	126
Portugal	599	114	103	129	124	127	127	107	127	148
Greece	2,393	113	-	-	-	136	-	-	-	-
Ireland	150	123	-	-	-	-	-	-	-	-
United Kingdom	1,760	84	-	-	-	-	-	-	-	-

- = Not available.

Source: Organization for Economic Cooperation and Development, Environmental Indicators, Paris, France, 1991.

**Table 7--Fungicide use trends**

Country	1975	1980	1981	1982	1983	1984	1985	1986	1987	1988
	Tons ----- Index (1975=100) -----									
Denmark	432	154	-	402	521	556	557	427	243	273
Germany	5,291	124	133	136	143	162	160	164	174	-
France	14,600	271	310	388	350	388	340	345	310	341
Italy	93,203	171	130	104	88	-	91	101	123	-
Netherlands	2,418	-	-	-	-	164	180	148	168	172
Portugal	15,902	131	82	79	63	88	88	58	60	64
Greece	28,292	90	-	-	-	97	-	-	-	-
Ireland	170	124	-	-	-	-	-	-	-	-
United Kingdom	2,640	181	-	-	-	-	-	-	-	-

- = Not available.

Source: Organization for Economic Cooperation and Development, Environmental Indicators, Paris, France, 1991.

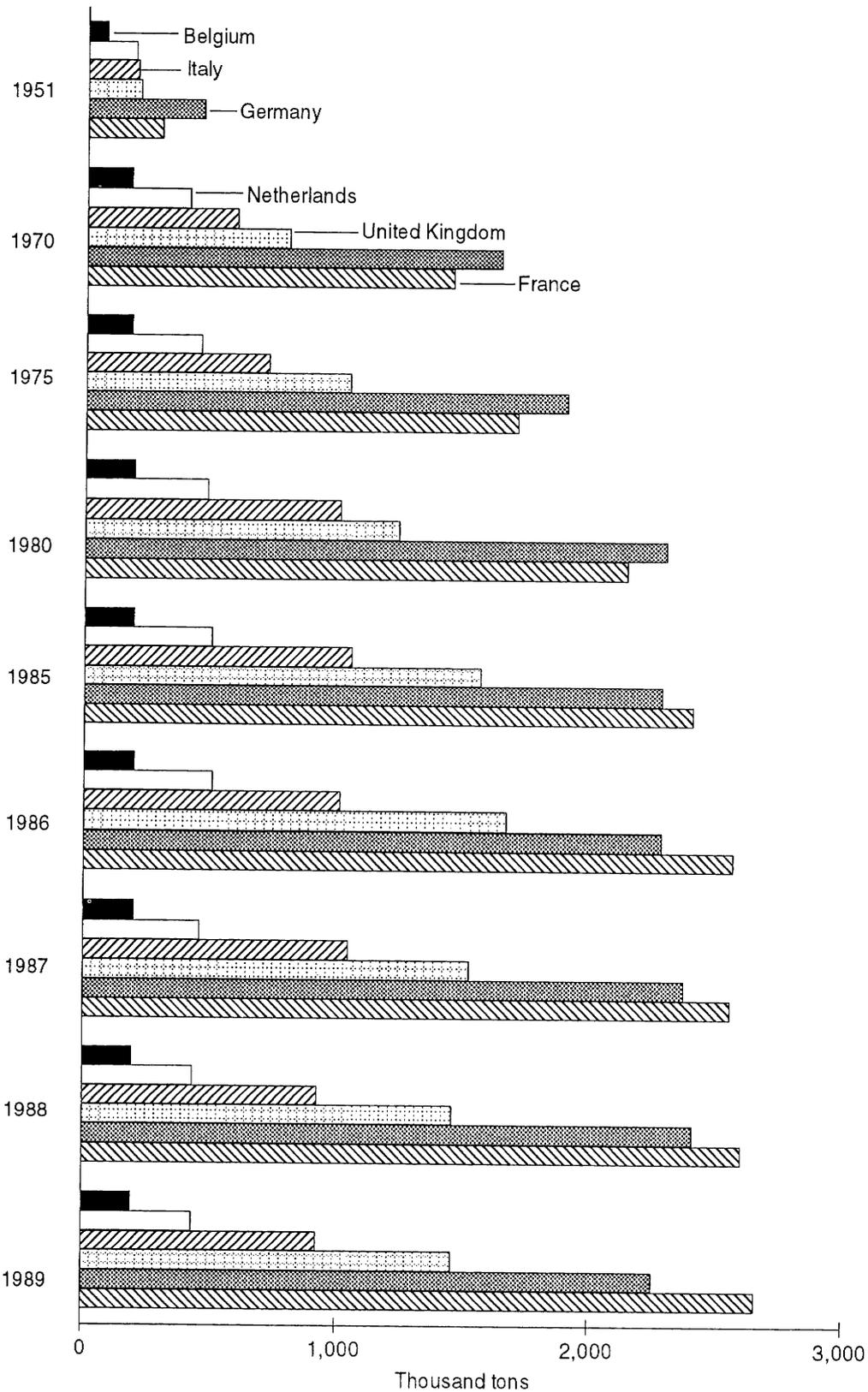
creased by 19 percent and insecticide use by 48 percent between 1980 and 1987.

Type of crop and crop mix are important determinants of pesticide use levels. Table 9 depicts historical use by crop for six EU members before 1992. Differences in application rates are much larger between

Figure 3

### Nitrogen fertilizer use

Fertilizer use grew dramatically in some European Union countries as policies promoted surplus production of certain commodities for export



**Table 8--Herbicide use trends**

Country	1975	1980	1981	1982	1983	1984	1985	1986	1987	1988
	Tons	-----Index (1975=100)-----								
Denmark	3,915	99	-	132	126	120	120	103	102	102
Germany	15,700	133	124	113	123	120	111	119	108	-
France	22,800	143	134	137	137	142	157	155	150	158
Italy	14,297	155	155	174	182	-	198	208	219	218
Netherlands	4,804	-	-	-	-	83	83	79	81	76
Portugal	794	141	101	120	117	135	133	165	172	180
Greece	908	185	-	-	-	288	-	-	-	-
Ireland	830	127	-	-	-	-	-	-	-	-
United Kingdom	21,300	132	-	-	-	-	-	-	-	-

- = Not available.

Source: Organization for Economic Cooperation and Development, Environmental Indicators, Paris, France, 1991.

**Table 9--Annual pesticide use per selected crop in selected countries**

Crop	Netherlands	Germany	France	Italy	United Kingdom	Denmark
	Kilograms of active ingredient per hectare					
Cereals	2.5	-	2.2	0.8	3.4	3.6
Sunflower	-	2.7	1.5	-	-	-
Rapeseed	1.9	-	-	.4	4.4	2.7
Pulses	5.7	-	-	1.2	2.7	4.8
Maize fodder	1.9	1.6	2.8	2.2	-	1.3
Sugar beets	4.8	4.1	4.8	5.3	3.5	3.7
Potatoes	12.5	6.8	-	5.1	5.8	5.7
Field horticulture	29.1	-	-	12.2	5.7	7.5
Grapes	-	-	54.9	42.2	-	-
Citrus	-	-	-	14.9	-	-
Fruit trees	20.7	-	-	-	-	-
Greenhouse vegetables	-	105.0	-	-	81.9	-

- = Not available.

Sources: Netherlands, Vijftigschild, 1991, and Landbouw Economisch Instituut, various years; Germany, France, Italy, and United Kingdom, Agrofarma, 1990; Denmark, Dubgaard, 1987; all cited in Oskam and others, 1992.

**Table 10--Pesticide use trends 1/**

Country	1975	1980	1981	1982	1983	1984	1985	1986	1987	1988
	Tons	-----Index (1975=100)-----								
Denmark	4,757	104	-	159	167	169	169	134	124	127
Germany	24,981	132	127	118	125	130	120	126	120	-
France	41,200	187	196	227	219	236	228	231	209	225
Italy	142,760	162	133	116	109	-	116	110	136	137
Netherlands	17,439	-	-	-	-	119	120	118	104	104
Portugal	17,341	131	84	83	68	92	92	65	69	74
Greece	31,593	99	-	-	-	111	-	-	-	-
Ireland	1,166	126	-	-	-	193	-	-	-	-

- = Not available.

1/ Includes insecticides, herbicides, fungicides, plant growth regulators and fumigants.

Source: Organization for Economic Cooperation and Development, Environmental Indicators, Paris, France, 1991.

crops than on the same crop between countries. Therefore, the relative share of national crop acreage for specific crops determines pesticide use intensity.

The same is generally true of fertilizer use as preplant soil preparation fertilizer application practices are usually crop specific.

Aggregate pesticide use in the EU differs by region according to climatic and physical conditions, cropping systems, and associated pest problems (table 10). Pesticides are used heavily in the North Sea region where soil-borne insects and diseases thrive in the cool, moist maritime climate. Producers in the warmer, generally dry Mediterranean zone rely on pesticide applications to control pest damage on economically important fruit and vegetable crops. Pesticide use in Italy is especially heavy due to fungicide requirements in grape production.

Northern European farmers increased their use of pesticides until 1984 when use trends began to decrease. Aggregate pesticide use in Denmark dropped 25 percent between 1985 and 1988. West German farmers used 8 percent less, and Dutch farmers used 13 percent less. The combination of stricter environmental codes that limit pesticide and fertilizer use and commodity price/input cost relationships have contributed to decreased use. Although data are insufficient to completely describe use trends in Greece and Ireland, the available data indicate increased use between 1975 and 1984, by 11 percent in Greece and 93 percent in Ireland. Pesticide use in France increased dramatically (136 percent) between 1975 and 1984, but has plateaued since mainly due to market saturation; that is, commodity acreage on which pesticide use is economically beneficial is already being treated. Increased use rates would require severe pest infestations or the introduction of new crops supplanting acreage in use and requiring increased pesticide applications.

EU farmers apply pesticides more intensively than do U.S. farmers when measured in tons of pesticide applied per square mile of arable land (table 11, fig. 4). For instance, average pesticide application rates in 1991 were three times as great in the United Kingdom and more than twice as great in France and Germany when compared with U.S. use.

## Regional Differences in Environmental Concern

Distinctive physical differences in resource endowments characterize the agricultural production regions in the EU. Differences in climate and soil types, characteristics and extent of nonproduction vegetative cover, depth of freshwater aquifers, extent of arable land area, and type of crop production system, in turn, all influence a particular region's susceptibility to environmental degradation from agricultural production practices. A natural line of demarkation divides the

**Table 11--Pesticide use on arable land in selected countries**

Country	1989	1990	1991
Tons per square mile			
United States	0.27	0.28	0.28
France	.44	.44	.74
Germany	.42	.42	.71
United Kingdom	.58	.58	.94

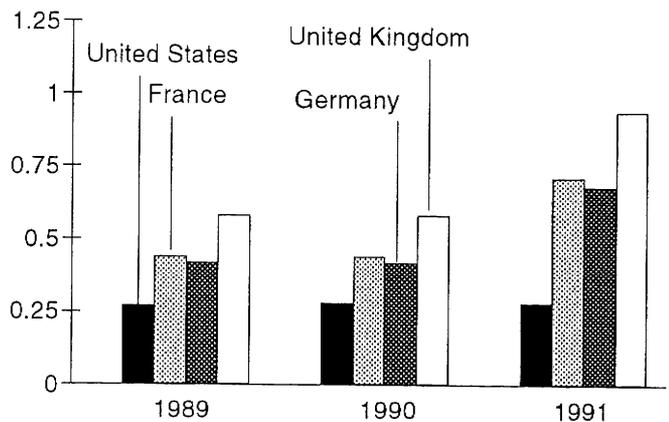
Sources: For United States, U.S. EPA, 1992. All other data from Organization for Economic Cooperation and Development, *State of the Environment*, Paris, France, 1991.

Figure 4

## Pesticide use

Pesticides are used more intensively in countries of the European Union than in the United States

Tons/square mile arable land



Sources: For United States, U.S. EPA, 1992. All other data from Organization for Economic Cooperation and Development, *State of the Environment*, Paris, France, 1991.

EU into northern and southern production regions; the North, in general, includes nations bordering the North Sea, while the South is comprised of Mediterranean Europe.

## Northern Europe

The northern regions are rich in resources, both agriculturally and otherwise, and are located within and around the London-Milan axis, and also include Denmark, the Netherlands, the Paris basin, and the central and northwestern regions of Germany (de Wit, 1988). Within these regions, environmental problems attributable to agriculture are significant, and governments have taken pioneering regulatory steps to restrict

chemical input use to limit or reverse environmental damage.

### ***The Netherlands***

Water quality is a major concern in the Netherlands, where little diversity in cropping patterns invites management methods that lead to environmental contamination. The use of soil fumigants to combat nematodes in potato production in the north exposes a very high water table to contamination through leaching. Intensive animal production on the sandy soils of the south and southeast creates problems of nitrogen leaching through overapplication of excess manure. In addition, volatilization of ammonia from animal manures contributes to acidification of rainwater and snow and subsequent forest and crop damage.

Dutch farmers use approximately 42 million pounds of plant protection chemicals each year, or about 18 pounds per acre. Belgian farmers average 11 pounds per acre, the French and Swiss average 5.3 pounds per acre, and German farmers average 3.6 pounds per acre (*AgraEurope*, Nov. 6, 1992). U.S. farmers average 2 pounds per acre. The intensive use of pesticides in the Netherlands is generally attributed to the maritime climate which is conducive to the growth of fungal and bacterial diseases. Because Dutch farmers concentrate on production for export, they must observe phytosanitary regulations of importing nations, especially in propagative materials, such as seeds and bulbs, and floriculture.

Much of Dutch agriculture is also devoted to potato production in rotation with sugar beets. This limited rotational scheme promotes the development of nematode infestations and soil-borne diseases, which are effectively controlled through soil fumigation with pesticides. About 75 percent of Dutch pesticide use is directed toward the control of soil insects and nematodes. Because of the problems of pesticides leaching into groundwater aquifers, new input-use regulations stipulate that soil sterilization products, which are injected directly into the soil to deliver maximum effect, can only be purchased on Government prescription and can be applied only every 4 years to a particular field. Direct injection increases pest exposure to soil fumigant effects but also facilitates groundwater contamination in susceptible aquifers by bypassing layers of soil-borne detoxifying bacteria.

In June 1991, the Dutch Government instituted a plan to decrease pollution pressures from agricultural practices including measures to decrease livestock numbers, especially swine, to lessen the manure surplus, which is currently estimated at 15 million tons

yearly. (A manure surplus is the amount exceeding what can be effectively spread and incorporated into the soil as a soil nutrient enhancer.) Or alternatively, the construction of manure processing plants has been proposed in which the surplus could be dried, packaged, and sold for export. The plan calls for the use of fertilizers to be decreased by 35 percent by 1995 and 50 percent by 2000. The projected use rates will be measured against 1985 use levels. Farmers will initially be allowed to try to reach these goals by whatever means they deem appropriate. If, however, the initial goal is not met by 1995, the Dutch Government and farm groups have agreed that some manner of taxation scheme will be instituted to raise input prices sufficiently to decrease consumption.

The Government has also decreed that farmers' use of plant protection chemicals will be reduced 50 percent by 2000, measured from 1985 base levels. About 320 active ingredients are used in 3,000 pesticide products marketed in the Netherlands. The list of allowed chemicals is to be purged of the most harmful products by 1995 and revised again by 2000. The initial phase-down plan called for the withdrawal from the market of 90 active ingredients thought to contribute the greatest environmental harm. Opposition by farm groups led to an interim compromise in which 18 chemicals most closely implicated in groundwater pollution were phased out at the end of 1992 (*AgraEurope*, Dec. 23, 1992).

Surveys indicate that 70 percent of the Dutch citizenry would forgo higher living standards for a cleaner country (OEC, 1990). However, the Dutch Institute for Agricultural Economics has estimated that input restrictions will financially harm 30 to 50 percent of Dutch farmers (Oskam, 1993). The Dutch Government has offered a plan to provide financial assistance to the agricultural sector for the development of production technologies that address environmental and food safety concerns while maintaining economic and technical efficiencies.

### ***Denmark***

The Danes face many of the same problems as the Dutch: nutrients leaching into groundwater due to overapplication of animal wastes, soil insect problems caused by narrow crop rotations, and the loss of species diversity. Public policy to limit environmental damage from farm practices has centered on regulatory measures. The 1987 Aquatic Environment Program obliged farmers to assure that adequate storage existed for excess manure that could not be effectively used on farm. Farms larger than 25 acres were ordered to prepare fertilizer management plans

to decrease nitrogen leaching by 50 percent by 1995. If environmental objectives fall short then a tax on fertilizer use is to be established with proceeds to be returned to agriculture to fund educational programs focusing on pollution control (*AgraEurope*, July 15, 1992).

In line with the national goal of reducing pesticide use, the approximately 250 active ingredients registered for use in Denmark in 1988 were reevaluated for possible harmful environmental and human effects. As a result, 32 chemicals were withdrawn from use in 1989 because of unacceptable levels of toxicity. The national goal is to reduce pesticide use 50 percent by 1995. The interim target of a 25-percent reduction by 1990 was reached in 1988.

Danish policymakers hope that the gradual movement toward fewer and larger farms will help relieve the pressures being placed on the environment by current production practices considered too intensive and environmentally harmful. Further, the Danish Government has allocated the equivalent of 50 million kroner (\$7.8 million) through 1997 for research and development of organic farming practices and is providing financial assistance to farmers wishing to convert from conventional to organic farming methods. During conversion from conventional to organic, crop yields in Denmark typically drop 30 to 60 percent, and interim output cannot be sold as strictly organically grown, placing a financial burden on farmers. Though the conversion grant scheme expired at the end of 1992, a permanent conversion plan funded by the EC farm extensification grants is being planned (*AgraEurope*, July 15, 1992).

### **France**

France is the largest market for agrichemicals within Europe. About \$2.5 billion was spent in France on plant protection and fertilizer products in 1991, about a third of the total Western European market (*AgraEurope*, Dec. 23, 1992). The growing influence of French environmental action groups and the recent discovery of nitrates in drinking water supplies have prompted a heightened awareness of the negative effects of input-intensive agricultural practices.

As a result of this increased awareness, a "Green Plan" was made public by the French Minister of the Environment in June 1990 with goals being the prevention and reduction of pollution, management of water resources, preservation of rural landscapes, and protection of wildlife. In April 1991, the Environment Ministry introduced a "Water Plan" to better manage French water resources and lessen pollution

from both point and nonpoint sources. The plan tightens rules for water use, requiring users to pay true water consumption costs rather than a token lump sum as in the past (Danel, 1993). Related legislation enacted in February 1992 requires French farmers with livestock to obtain governmental permission before increasing the number of animals on the farm. Requests by farmers to increase herd size will be judged based upon the ability of the farm to handle waste disposal. Enforcement may prove difficult, however, considering the strength of French farm groups in opposing regulations that may impose economic hardship on their members.

### **Belgium**

The Belgians have adopted legislation imposing restrictions on the application of fertilizer to farmland. The law is similar to Dutch legislation but goes further by including inorganic fertilizers, whereas the Dutch concern is with animal manures. The Belgian act also sets allowable application periods. A prohibition exists on manure spreading between October 1 and April 1 when the problem of nitrate leaching is compounded by heavy winter precipitation in most years. The Dutch impose the same calendar restrictions. Total manure production in Belgium is 41 million tons of which 8 million is surplus.

### **Germany**

Agricultural production in the former West Germany increased 60 percent between 1960 and 1990, labor use decreased by 73 percent, the land area in farms decreased by 6 million acres or 16 percent of the available arable land, and the number of farms decreased by 55 percent (CEC). Gross production per acre increased by 93 percent between 1960 and 1990, and the use of nitrogenous fertilizers rose 150 percent. The German Government is concerned about the environmental pressures caused by agricultural intensification and has identified areas in which governmental control will be focused. These include groundwater contamination by nitrates and pesticides, soil erosion and compaction, endangered species, contamination of surface water and the resulting decrease in dissolved oxygen, food safety and quality, and air pollutants (von Heydebrand, 1993).

The German Government has entered into contracts with individual farmers to decrease intensive agricultural production practices, to lessen pressures on the environment, and to curtail production of surplus commodities. These contracts include payments for practices such as leaving crop edges unsprayed and meadows unused during wildlife hatching periods.

Some regions have also enacted local ordinances which prohibit use of pesticides on nonagricultural fields and the conversion of forested areas to agricultural uses.

### **Southern Europe**

The countries in the Mediterranean region are generally less developed than their northern neighbors and characteristically express a greater concern for "pulling even" economically rather than controlling or cleaning up the negative effects of agricultural productivity increases and industrial expansion. The less developed EU nations are those most recently integrated as members: Spain, Portugal, Greece. Ireland in northern Europe and the southern regions of Italy are also considered less developed.

The EC budgeted 1.2 billion ECU (European currency units, \$1.5 billion) for environmental projects for the less developed regions during 1989-93. The money has been used to combat air pollution, preserve the countryside, promote clean technologies, and combat soil erosion and desertification. In 1990, the EC Commission established a program to combat pollution in the most economically depressed coastal Mediterranean communities. The program aims to improve water purification and sewage treatment facilities. Estimates indicated that, in 1989, 250 coastal towns with populations 10,000 to 100,000 persons eligible for EC support either had no infrastructure for sewage treatment or disposal or were deficient. In Italy, 48 percent of the existing 1,580 sewage treatment works no longer functioned; 66 percent of those in the south of the country were nonfunctional. In Spain, 80 percent of municipalities were without treatment plants, and some existing plants were not functional (Solsten and Meditz, 1990).

As for agriculture, southern European farmers specialize in the production of fruits and vegetables, livestock, olives, sunflowers, tobacco, and some cereal grains. The quality of arable land is considered marginal compared with the northern countries. Yields are low relative to the rich North Sea region, and environmental issues deal principally with soil erosion, desertification, and forest fire prevention. In Portugal, for instance, 26 percent of the land area is suitable for agricultural use considering topography, soil fertility measures, and yield potential. However, 46 percent of the land is used for agricultural purposes. High- and average-fertility soils are rare, and there is little agricultural diversity. Farm incomes are low and production costs high. In 1989, the average Portuguese farm was 17 acres (CEC, 1992).

### **Spain**

About 40 percent of Spain's 125 million acres of land is considered suitable for cultivation, although the soil is of generally poor quality. The roughness of the terrain is a major reason for the slow adoption of new agricultural techniques. Farm size is another. Twenty-five percent of Spain's 2.3 million farms consist of fewer than 2.5 acres of land, and 62 percent have fewer than 12 acres (Solsten and Meditz, 1990). Most of the natural forests of the Iberian Peninsula have disappeared because of erosion and uncontrolled harvesting for firewood, timber, and the creation of pastureland. A reforestation program has been underway in Spain since 1940 with aims of meeting market demand for forest products, controlling erosion, and providing seasonal employment in rural areas. The use of nitrogen fertilizer doubled from 578,000 tons in 1970 to 1,109,000 tons in 1989. Pesticide use has not been effectively documented to allow general conclusions regarding historical and future use trends.

### **Italy**

In Italy, farming plays a greater economic role in the southern regions. Southern farming, however, has been hindered by poor soils, an arid climate, and rugged terrain. While 80 percent of Italy is classified as hilly or mountainous, 52 percent of the land had been devoted to agriculture in 1990 (CEC, 1992). Small farms predominate with 3.3 million farms covering 58.3 million acres and averaging 18 acres in size, the second smallest average farm size in the EU. Seventy-five percent of farms were smaller than 12 acres. Many holders of small farms in the north have invested heavily in intensive hog and poultry operations creating a modern livestock complex (Shinn, 1985). Italy has become the EU's leading producer of fruits and vegetables as well as the world's largest producer of wine. Production growth has been realized partly through the heavy use of chemical pesticide products. In 1988, Italian producers used approximately 420 million pounds of formulated pesticide products of which about 60 percent were fungicides used heavily in viticulture and horticultural crop production (tables 7 and 10).

### **Greece**

Greek agricultural productivity was low in the mid-1980's relative to other EU nations. Although the agricultural labor force declined 1 to 2 percent annually during the 1980's, it remained large in comparison with other EC countries (Shinn and Keefe, 1985). Unfavorable terrain, arid climate, small farm size, lack of capital investment, and insufficient irrigation kept productivity levels low. About 30 per-

cent of the Greek land area is arable, although 45 percent of arable land is mountainous or semimountainous, causing low yields due to poor soils and difficult farming conditions. Greece is the principal producer of cotton in Europe and second leading producer of tobacco behind Italy. Small land-holding patterns, however, have caused the Government to encourage fruit and vegetable production to exploit labor-intensive production techniques. Nitrogen fertilizer use increased from 201,000 tons in 1970 to 426,000 tons in 1989. The sparse data describing Greek pesticide use indicate a 12-percent increase in use between 1980 and 1984, the last year for which comprehensive data are available.

Maintaining marginal farms is a key concern of agricultural policy in the southern EU countries. The agricultural economy is directly linked to the traditional rural heritage and social structure of the Mediterranean region. Measures to ensure the continued existence of southern farmers have occupied individual national assemblies as well as the collective EU.

## The Common Agricultural Policy

The objectives of the CAP were established in line with the original Treaty of Rome, which created the EC in 1958. Enacted in 1962, the CAP aims to guarantee food security at stable and reasonable prices, to improve agricultural productivity through technical progress, and to provide farmers with a reasonable standard of living. Depending on the product, the CAP delineates common rules on competition, compulsory coordination of the various national market organizations, or a European market organization.

In managing the common organization, the EU can regulate prices, provide marketing and production aids for different products, prescribe storage and carryover arrangements, and provide common arrangements for exports and imports to assure the price regime (CEC, 1987, *Official Journal*). As initially conceived, the EC authorities wanted to support farm incomes by means of indirect support measures to stabilize producer prices while improving productivity through structural policies. Structural improvements have differed by country but generally involve public investment in transportation and education and subsidized credits for investment (Rosenblatt and others, 1988).

In the years since the CAP's inception, its production objectives have been realized. Productivity gains

have been prodigious, to the point that the excess supply of some foods has become a problem. Between 1973 and 1988, the volume of agricultural production in the EC increased by 2 percent per year. Food spending has decreased as a percentage of the average household budget, though prices for some foods remain artificially high due to the EU's intricate system of price supports.

Since the mid-1980's, the EU has decreased price supports for some surplus products to alleviate the financial burden on the its budget. However, CAP expenditures increased from ECU 4.5 billion (\$5.6 billion) in 1976 to ECU 35.9 billion (\$44.9 billion) (1992 prices) in 1992 (USDA, 1992). Internal consumption of agricultural commodities grew by only 0.5 percent per year between 1973 and 1991. The stocks that built up by 1991 were valued at ECU 3.7 billion (\$4.6 billion). The EU has had to increase agricultural exports to maintain prices. Agricultural programs and policies accounted for 53 percent of total EC budget expenditures in 1992 (USDA, 1992). More than 30 percent of the expenditures were spent on milk products, meat, eggs, and poultry, the commodities that received the highest levels of protection. In 1992, support to milk products constituted 16 percent of total expenditures, while meat, eggs, and poultry producers received about 20 percent of the total. The on-budget expenditure subsidies are in addition to the higher prices paid by consumers for subsidized agricultural products due to border protection and internal price supports. Other commodities, the producers of which received large monetary transfers under the pricing policies of the CAP, were cereals, sugar, and oilseeds (USDA, 1992).

CAP expenditures have produced a number of positive outcomes. The EU's balance of trade has been markedly aided by agricultural exports. EU farmers have adopted labor-saving technologies. Real farm incomes for EU farmers have steadily risen (now more stable than farm incomes in the United States). Heavy input use has led to exceptionally high field crop yields. However, the CAP has also directly or indirectly contributed to unwanted effects. EU food prices are higher than in world markets. Surplus production continues for some commodities. High input-use levels have created environmental problems. Its heavily subsidized agricultural exports policy has led to accusations that the EU engages in unfair trade practices. CAP expenditures for surplus food commodities in the late 1980's were equivalent to 49 percent of the final value of agricultural output in the EC compared with 22 percent in the United States (OECD, 1988). Further, farm incomes have risen in

an inequitable way, with support directed toward the largest and most intensive farms typically in the north. Eighty percent of the support provided by the EC is devoted to 20 percent of farms, which typically are the largest (Williams, 1991). Some have argued that these policy structures have contributed to slower economic development in the Mediterranean region.

The CAP as originally implemented corresponded well to a food-deficit situation. The principal objectives of food security and income maintenance meshed successfully with the overall EC objective of economic growth. Now that the agricultural sector has moved into a situation of surplus significantly beyond the absorption capacity of the domestic market, CAP goals and EU expectations have been refocused in response to budget constraints, economic pressures exerted by EU trading partners, and environmental concerns.

## CAP Reform

The agricultural policies instituted by both the EU and its member nations have had the same general overall objectives: to stabilize farm incomes and protect the once fragile agricultural economy from the pressures of world market competition. Artificially high domestic prices were established and imports restricted. However, the overproduction generated by high subsidy prices must be exported or stored, both at significant cost to taxpayers. High commodity prices set behind import barriers provided the EC agricultural sector total transfers from consumers and taxpayers of \$300 billion in 1990 (Viatte and Cahill, 1991).

Before the CAP reform, there had been significant movement toward community-wide coordination of environmental policy. The first community action program on the environment was adopted in 1973. Its aim was to harmonize and coordinate national policies around the notions that the polluter should pay for the cost of cleanup, that preventing degradation of the environment was preferable to cleanup efforts, and that all community policymaking should take into account environmental effects. EC environmental action programs were also instituted in 1977, 1983, and 1987. Those programs dealt with drinking water quality and bathing water standards, lead and sulphur dioxide air pollution, car exhaust emissions, aircraft noise levels, waste management, and the requirement to perform an environmental impact study prior to initiating any large-scale industrial or infrastructure project.

A major reform of the CAP was adopted by the EC in May 1992 to take effect during the 1993/94 marketing year. Policy changes include direct payments to farmers and increased measures to limit production. Support prices are reduced, new supply control measures have been introduced, and direct producer payments established to compensate for commodity price cuts for grains, beef, dairy, and sheep (Madell, 1993). The oilseeds support regime was reformed in 1991 to provide direct payments to producers rather than price supports.

The reforms also include programs specifically designed to produce environmental benefits. A prolonged set-aside program would remove land from production for a minimum of 20 years for the purpose of creating natural parks to promote preservation of native plants and animals. Reduced-input production methods are encouraged through financial incentives, as is promoting the planting of trees on agricultural land. Educational programs to train farmers in environmentally sound production practices are also planned.

The EU has more recently tried to integrate environmental objectives with other EU sectoral policies. The Single European Act in which trade and tariff barriers were to be eliminated at the end of 1992 has been a motivating force in establishing uniformity in the codification of environmental standards. The elimination of commercial restrictions between nations without assuring uniformity in environmental codes would lead to unfair advantage for nations with less stringent regulations.

Although the basic principles of the CAP will remain dedication to the single market, EU preference, and financial solidarity, other stated objectives include the following:

- Maintaining farm families on the land to preserve what is deemed to be the fabric of European society and to develop and enhance a vital rural economy;
- Emphasizing environmental stewardship along with production efficiency in devising new policies and programs;
- Restoring and maintaining an equilibrium between supply and demand under conditions of rising agricultural productivity and saturation of demand;
- Encouraging decreased input-use intensity in production to reduce surplus commodities and help sustain the resource base;

- Recognizing the strong position of the EU in international trade as both the world's leading importer and leading exporter and, hence, the need to promote domestic consumption;
- Reducing regional differences in prosperity and growth prospects;
- Maintaining agriculture in less endowed regions to preserve the landscape and to contribute to nature conservation; and
- Recognizing the demand for lower prices by the consumer.

Stating contemporary objectives, however, and realizing the goals of those objectives depend on the ability to implement policies that address concerns and that are financially feasible. Achieving many of the stated goals will require a substantial long-term commitment of EU financial resources. Some stated objectives may be incompatible: for instance, maintaining family farms to promote the rural economy, enacting supply controls, and facing the financial realities of limited EU and member nation budgets. Maintaining a portion of the rural population in a custodial function for landscape preservation or for intangible ethical reasons--preserving historical roots or the structural fabric of European society--will be costly to implement and maintain. Supply control implies lessened input demand and subsequent economic hardship for agribusiness and rural communities. Promoting alternatives to intensive input use, including maintaining output levels over a larger acreage, exposes a larger geographic area to the inherent environmental problems that agricultural production imposes as it affects biodiversity and resource depletion and contamination.

Setting priorities necessarily relegates some stated goals to secondary status. Policymakers must determine which are politically important, technically feasible, and financially affordable. These criteria are easily determined, but political consensus among competing groups is generally difficult to effectively sustain for the time required to realize results.

## Implications for U.S. Agriculture

The relative importance of agriculture in developed nations diminishes as those nations restructure to adapt to changing global economic, political, social, and environmental conditions. The necessary institutional changes during the adaptation process are often diffi-

cult to manage to assure optimum outcomes for all individuals in all nations. The economic maturation of a nation also raises the demand for resource conservation and environmental integrity. These dual forces, the increasing importance of environmental protection and the necessary abdication of agriculture through its own technological success as a seat of economic power in developed economies, are at work in both the EU and the United States.

Continued productivity growth is important for developed agriculture to respond to world food demand and to remain economically healthy as subsidies decline. The agricultural sector in the developed world faces a regulatory and political climate that may limit productivity through input restrictions and similar measures designed to alleviate environmental degradation.

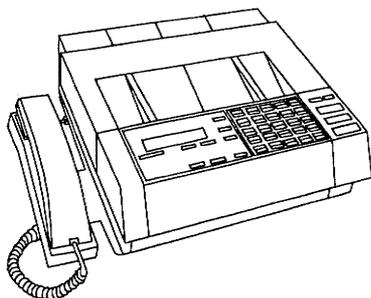
These forces have pushed modern agriculture in both the EU and the United States to a vaguely defined intermediate point in which productivity is maximized subject to environmental constraints that become increasingly limiting over time. Nations that have put in place measures to promote environmental quality and to limit or reverse degradation due to agricultural production activities can expect the growth in productivity to be limited or to decline as rules and restrictions evolve. Trends toward expanded acreage coupled with input restrictions will contribute to limiting output growth in affected nations.

The environmental consequences of agricultural intensification have been markedly more acute in northern Europe than in the United States because of the concentration of arable land and the inability of the land to easily dissipate heavy input loadings. EU problems of overproduction and supply disposition may be self-limiting if environmental problems do not respond to current regulatory measures and additional, more restrictive measures are applied. Decreased output may result.

The problems of environmental degradation due to agricultural production practices in the United States, while of growing concern, are not as compelling as in some northern European nations. Input intensity in U.S. agricultural production is only a fraction of that in Europe, and the arable land area is much more extensive. American farmers will face less severe tradeoffs between productivity and environmental preservation.

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  - U.S. agricultural exports are expected to increase by between \$1.6 billion and \$4.7 billion in 2000 and between \$4.7 billion and \$8.7 billion in 2005.
  - Increased exports mean more export-related jobs, particularly for high-value and value-added products.
  - Increased exports will raise farm prices, increase farm income, and lower Government outlays on price and income support programs.
- Perhaps even more important for the *future* is the discipline the Uruguay Round will apply to countries that might otherwise choose closed markets, production-inducing internal supports, and subsidized exports. This agreement has important consequences for our large trading partners that are currently outside the GATT: China, Taiwan, and the nations of the former Soviet Union.

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