

Environmental Regulations and Competitiveness

Dale Colyer
West Virginia University

Working Paper 2004-1

Abstract: Costs of environmental regulations, although relatively small, can be critical in the competitiveness of a product since the cost advantages of producers in one country are often very slim. Additional costs derived from new regulations are a factor in the continued importance of exports and of the maintaining or increasing a nation's share of the international market. Governments try to assist their industries in overcoming the disadvantages caused by such added cost through subsidies, tax breaks, technical assistance or in other ways. In agriculture these are increasingly taking the form of green payments, which are currently exempt from the limits imposed on domestic subsidies. In addition to these mechanisms for addressing the environment, there also has been a selective but subversive process of erecting non-tariff barriers based on environmental protection issues. It is often difficult to determine if such measures are really for protecting the environment or for protecting domestic producers. They are, none-the-less, generally effective approaches for achieving environmental objectives and can also be effective measures to alter competitiveness. Competitiveness can be either enhanced or diminished by the environmental regimes of competing nations. The existence of negative externalities means that prices are lower than would prevail if all costs were included in the prices of the products.

Keywords: agricultural trade, competitiveness, environment, trade and environment, environmental regulations, agricultural policy, protection

JEL Codes: F1 - Trade, F13 - Trade Negotiations, Protection, F18 - Trade and Environment, K32 - Environmental Law, Q18 - Agricultural Policy

Contact:

Dale Colyer
Agricultural & Resource Economics
West Virginia University
P.O. Box 6108
Morgantown WV, 26506-6108
Phone: 304-293-4832 x 4479
FAX: 304-293-3752
email: dcolyer@wvu.edu

Copyright © 2004 by Dale Colyer. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.

Environmental Regulations and Competitiveness

Dale Colyer

Most production and consumption activities have side effects including the creation of waste products that must be disposed of in the environment and that tend to damage and degrade natural ecosystems. Public policy measures (regulations and/or incentives) to protect and enhance the environment have a long history, but have become much more important in recent decades. Environmental concerns in the U.S. attained critical status during the 1960s, an era exemplified by the 1962 publication of Rachel Carson's *Silent Spring*. Subsequently, the Environmental Protection Agency (EPA) was established by the Federal Government and the U.S. Congress, as well as many state legislatures, has passed a large body of environmental legislation including, at the Federal level, the Clean Air and Water Acts, pesticide regulation, solid waste disposal rules, contaminated site cleanup funding, the endangered species acts, recycling provisions, etc. There also has been a host of multinational activities through multilateral environmental agreements (MEAs) such as those controlling trade in endangered species (CITES), banning of use of chlorofluorocarbons to prevent the enlargement of the ozone hole, maintaining biodiversity, controlling greenhouse gas emissions, etc. Trade agreements became a factor in this web of environmental activities with the inclusion of environmental provisions in the North American Free Trade Agreement (NAFTA) and the Uruguay round of the General Agreement on Trade and Tariffs (GATT), which also established the World Trade Organization (WTO). Most other nations have environmental regulations which vary from extremely strong in most industrialized countries to very weak in a few of the least developed countries, which neither have the resources nor will for stronger measures to protect the environment.

Environmental regulation is used here to designate the wide variety of measures and tools used to prevent, control and/or mitigate environmental damage resulting from production and consumption activities of human beings. These include the use of police power, i.e., laws and regulations that prohibit actions that cause environmental damage or require actions that improve the environment and that are enforceable by civil or criminal actions through the courts or semi-judicial bodies, pollution taxes such as taxes on emissions, market related activities implemented through government such as trading in emission rights, and subsidies or other incentives to induce individuals and firms to adopt methods that protect or improve the environment. They also include measures used to reverse damages caused by past activities such as clean up of pollution sites, surface mine reclamation, etc. Some environmental organizations have been very active in promoting public actions to protect the environment as well as in carrying out privately supported activities; some organizations, however, have been destructive of private and public property and exhibit extreme biases toward the environment.

It is sometimes difficult to determine if a particular activity or regulation should be classified as environmental, health, quality of life, or other measure since they are interrelated and many have multiple objectives, including protectionism (see, e.g., Charnovitz 2002). For example, genetically modified organisms may be regulated or prohibited for health or environmental reasons or both. Sanitary/phytosanitary provisions are imposed for protecting the health of people, animals or plants and for environmental reasons, such as prevention of the introduction of harmful species of plants or animals, including insects, as well as bacteria or

viruses that cause diseases, but they may also be set up specifically to protect a domestic industry from competition (O'Connor 2003).

Although much of the environmental regulation was directed at industrial production, agriculture was affected as well, especially by the pesticides regulation and clean water acts. Agriculture has been and continues to be a major contributor to environmental degradation (see, for example, Bromley 1966; Peterson, Boisvert, and de Gorter 2002; Srivastava and Alderman 1993; Tilman et al. 2001). These legacies include soil erosion; pesticide contamination and poisoning; fertilizer runoff and volatilization; air pollution and green house gas generation through dust, fossil fuel burning, land clearing, and animal flatulence; water depletion through irrigation and an accompanying soil salinization and compaction; loss of biodiversity as land is cleared and mono-agricultural production techniques used; and perceived threats to health via genetically modified organisms (GMO), hormone and antibiotics utilized in animal feeds, pesticide contamination of fruits and vegetables, etc. In the water area, much of the industrial and municipal point pollution problem has been successfully addressed and, consequently, attention has turned to non-point pollution with agriculture as a major culprit. Fertilizer and chemical runoffs are major contributors to non-point water pollution. Large scale poultry, pork, dairy and beef production units have led to major problems associated with animal waste disposal, especially as that relates to water pollution. Because of these and related issues agriculture has become subject to a greater variety of environmental regulations, regulations that the sector was often exempted from in the past when regulatory measures were applied to other industries.

Environmental regulations are an issue in competitiveness since they may increase the costs of production, making those who are affected less competitive than producers not facing similar regulations. In addition, environmental issues and protection have become important to many consumers and others with environmental concerns who seek to impose restrictions on what products can be marketed or the circumstances under which they can be sold. Thus, U.S. environmentalists and consumers have been able to persuade Congress to ban imports of tuna caught in ways that harm dolphins and shrimp in ways that kill sea turtles (Hudson et al. 2003), while Europeans have banned beef fed with hormones and have a moratorium on food produced from genetically modified seeds. Similarly citrus and other products from certain areas may be banned due to fruit flies and other pests—the control of invasive species is critical to the health of domestic industries and the general environment, including biodiversity (see Evans 2003). Other countries ban imports of poultry with any disease causing organisms such as salmonella, sometimes causing a virtual ban on imports, or which are produced in countries where there have been disease outbreaks—nearly everyone banned imports of beef from Great Britain during the mad cow crisis and the foot and mouth disease outbreak. These environmentally related non-tariff barriers to trade are also a factor in the competitiveness of agriculture, including the ability of U.S. agriculture to sell in many markets. While regulations related to agricultural production are important, an increasing share of U.S. agricultural exports are in the form of processed products and, thus, regulations that affect the food processing industries also are a factor in the sector's competitiveness.

This section of the paper examines the competitiveness of agriculture as it is affected by environmental regulations. It includes an examination of the conceptual (theoretical and practical) bases for the effects of environmental regulations on competitiveness, which are covered in the next section. Then, agriculture's contributions to environmental problems are covered. Following that, the nature of U.S. general and agricultural sector's environmental regulations vis-à-vis its major competitors will be discussed; this will include regulations

affecting agricultural production and those affecting industries that process agricultural products. Next, the role, extent and importance of environmentally related non-tariff barriers will be examined. This will be followed by a review and evaluation of research related to the effects of environmental regulations on the competitiveness of U.S. agricultural producers and processors. The final part of this section contains the conclusions and implications of environmental regulations for the competitiveness of U.S. agriculture.

Conceptual Underpinnings

The creation of waste products during production (consumption) causes costs, which are not borne by the producer (consumer) but by other persons or society in general (hereafter the discussion focuses on production but the reader should remember that the material also generally applies to consumption). These costs are called externalities since they are not reflected in the prices of the products, but are borne by those not involved in the particular economic transactions (see Zilberman and Marra, 1993). Air and water pollution are typical examples of externalities that producers create, including producers and processors of agricultural commodities. The major effect of the externalities is that the prices of the products are lower than they would be if all costs were included. This results in more of the product being demanded and produced, and more environmental damage. Thus, creation of externalities can be viewed as a form of indirect subsidization of the producer, an environmental subsidy since it is the environment and general public that suffer as a result. Environmental regulations are applied to reduce or eliminate undesirable externalities such as pollution and act, in effect, to internalize the costs, to make the prices more closely reflect the total costs of production, including the externalities.

The existence of externalities affects competitiveness since the indirect subsidies they provide to producers enable them to charge lower prices and makes their products more competitive. Elimination of externalities through their internalization will tend to raise prices of the products, making them less competitive, at least if other producers, say those in other countries, are not affected by a similar process of internalization. Furthermore, even when both countries have similar regulations, competitiveness may be affected if one country is more efficient in carrying out its regulatory regime or does not enforce it equally. In addition, many countries attempt to mitigate the effects of their environmental regulations on costs through various types of subsidies, including faster tax write-offs for pollution equipment, direct payments or other incentives. The latter include the green payments made to farmers, payments explicitly exempted by the WTO rules, which attempt to limit domestic subsidization of agricultural production in ways that distort trade. The U.S., for example, has used cost sharing for soil conservation and other practices through the Soil Conservation Service (SCS), now Natural Resources Conservation Service (NRCS) since the 1930s (Batie 1998). Although the purpose was to promote conservation and not to enhance competitiveness, that has been one of the results. These types of subsidies tend to have long-run effects from improved efficiency through protecting and enhancing the productivity of the soil or other natural resources. The subsidization of water from irrigation facilities provided by the public also enhances productivity and competitiveness, at least in the short-run. It also should be remembered that changes in costs due to environmental regulations will not necessarily result in changes in the direction, or even magnitude, of trade flows since it is comparative not absolute advantage that is the determining factor (Bhagwati 1996).

Many countries have attempted to protect their agricultural sectors through various types of trade barriers, both tariff and non-tariff types of barriers. Tariffs are transparent and have been the primary targets of GATT/WTO negotiations, although agricultural issues were excluded from most rounds of negotiations prior to the Uruguay Round, completed in 1994. Non-tariff barriers have included various devices including licensing requirements, quotas or import prohibitions, various types of sanitary/phytosanitary provisions (which may be legitimate measures used to protect human, animal and plant health), labeling requirements and other devices to restrict trade. One step to resolve these issues and eliminate non-tariff barriers made during the Uruguay Round was the tariffication of many non-tariff barriers, i.e., their conversion to tariffs, which were then to be reduced and eventually eliminated (Josling et al. 1994). This process resulted in very high tariffs for agricultural products in several countries. The negotiations also allowed appropriate regulations for health purposes if those were based on science and applied equally to domestic producers and *all* producers of imported products. Article XX of GATT allows environmental regulations as exceptions to the prohibition of trade barriers where these are imposed to protect human, animal and plant health, but the exact interpretation of this provision has been and continues to be a controversial subject, especially when applied unilaterally by one country, as in the cases of tuna-dolphin and shrimp-sea turtle regulations imposed by the U.S.

Agriculture and the Environment

Agricultural production and related activities produce significant externalities, i.e., have important negative effects on the environment that have led to government policies that are designed to eliminate or, at least, mitigate those effects. One critique, for example, says, “This eutrophication and habitat destruction would cause unprecedented ecosystem simplification, loss of ecosystem services, and species extinctions” (Tilman et al. 2001, p. 281). However, they also indicate that it may be possible to minimize or even reverse some of the trends leading to these pessimistic forecasts with appropriate mechanisms, but these cannot be achieved unless “far more resources are dedicated to their discovery and implementation” (p. 284). These externalities exist as activities that affect the natural resources used by farmers (land, water, air) or the health of humans or other living organisms. Soil erosion and other forms of soil degradation (compacting, salinization, water logging etc.) are results of farming activities, primarily crop production although livestock production also can be a factor, as in the case of overgrazing. Water quality is affected by siltation resulting from erosion and from runoff into streams or percolation into ground water of agricultural chemicals or from animal wastes. Air quality is adversely affected by wind erosion, burning of fossil fuels, land clearing through burning, and odors produced by concentrated livestock production. Biodiversity is diminished when farming activities such as land clearing or wetland drainage destroy the habitat of wildlife, fish, insects, etc. or through poisoning from pesticides (Carson 1962).

The effects of agriculture on the environment have been subject to considerable research (see, for example, Bromley 1996; Claassen et al. 2001). Bromley (1996, p. 3) recognizes both positive and negative externalities associated with agriculture and classifies them into three categories, those with amenity, habitat, or ecological implications. In this paper, the concern is only with the negative implications, since these are the ones leading to most of the regulations that have implications for competitiveness (although some, particularly the amenity benefits, may have cost implications and may be affected or required to some degree by

regulations—especially in Europe). Claassen et al. (2001, p. 2) list a number of negative environmental impacts produced by agriculture. Principal among these are water quality problems caused by sediments (soil erosion), runoff of water with dissolved nutrients, especially nitrogen but also phosphorus, and herbicide/pesticide contamination of water. They report research that indicates sediments as a major source of water quality problems and that there are high concentrations of nitrogen in water as a result of fertilizers and animal wastes which, for example, causes eutrophication in the Gulf of Mexico and other water bodies—an estimate is that 15 percent of the nitrogen and 3 percent of the pesticides used in the drainage area make it into the Gulf of Mexico. Some 37 percent of the ground water tested by the U.S. Geological Survey has at least minor traces of the principal herbicides used in farming. Reductions in water levels from excessive pumping of ground water can lead to subsidence and loss of productivity, while improper irrigation procedures cause salinization and/or water logging of land. Claassen et al. also say “soil particulate, farm chemicals, and odor from livestock are in the air we breathe” (p. 2). They further indicate that of the 643 species on the federal list of endangered species, agriculture has contributed to 380 being on that list. Wetlands conversions, an average of 31,000 acres per year during 1982-92, have been an important factor in that loss of biodiversity.

This brief summary of the environmental impacts of agriculture indicates the seriousness of the problems, which have been a major factor in the increases in regulatory activities in recent years and may be an indication of additional regulation in the future. Agriculture had been exempt from many of the regulations that affected industrial concerns, but as the sector has become characterized more by larger sizes of operations and control by large-scale processors of the products, much of the justification for exempting ‘family farms’ from regulations no longer applies. In addition, the relatively recent growth in concern for the environment has become a major political influence that affects agricultural and other legislation. One environmentalist, for example, called the 1996 Federal Agricultural Improvement and Reform Act (FAIR) a triumph for conservation (Warman 1996). It included regulatory features, although continuing the use of incentives, an approach utilized for agricultural conservation activities since 1933.

U.S. Environmental Regulation of Agriculture

The United States has a strong set of environmental regulations, but its environmental regulation regime is not as strong as those of a number of other industrial countries. In Esty and Porter’s environmental regulation regime index the U.S. ranks fourteenth, behind most of the major European countries as well as Singapore, but slightly higher than Belgium, Australia, Japan and Norway—Finland ranks number one followed by Sweden, Singapore and the Netherlands (Esty and Porter 2002, p. 93). The less developed countries along with Russia and other transition countries, generally ranked in the bottom half of the 70 countries included in the index—there was not sufficient data on many countries, including most African nations. This index represents the overall environmental regulation regime and, thus, does not apply specifically to agriculture, although regulation in agriculture is probably similar.

In the U.S., agricultural production activities are regulated primarily through three Federal Agencies, the U.S. Department of Agriculture (USDA, also one of agriculture’s primary supporters), the Environmental Protection Agency (EPA), and the Department of the Interior—this latter through the Endangered Species Act. In agriculture, the historical approach by the Federal Government has been principally one of incentives to induce improvements in the environment, an activity initiated in the 1930s with the SCS (now NRCS). The principal

regulatory/support activities related to the environment in the agricultural sector are shown in Table 1. Historically, the USDA has been the primary Federal agency involved in the agricultural sector, for both support and regulatory activities. The Department of the Interior has been involved through the Forest Service and federal lands, while the Corps of Engineers has been important through projects dealing with navigable streams and other agencies have had some involvement. States also have environmental regulations, which vary significantly and

Table 1. Environmental Regulations/Assistance Affecting Agriculture

Resource/Input	Law/Regulation	Policy Tool
Water	Coastal Zone Management Act	Regulations ^a
	Clean Water Act	Regulations
Soil	Conservation Technical Assistance	Incentives
	Conservation Reserve Program	Incentives
	Wetlands Preservation Program	Incentives
	Agricultural Conservation Program	Incentives
	Water Quality Improvement Program	Incentives
	Wildlife Habitat Improvement Program	Incentives
	Highly Erodible Land Conservation	Regulations ^b
	Conservation Compliance (Sodbuster)	Regulations ^b
Air	Wetland Compliance (Swampbuster)	Regulations ^b
	No Federal programs directly for agriculture	Not applicable
Wildlife	State Nuisance Law & Lawsuits to enforce	Legal actions ^c
	Endangered Species Act	Regulations
Labeling	Organic Certification	Standards

Source: ERS (see: <http://www.ers.usda.gov/briefingconservation...>)

a. Subject to regulations, if voluntary programs fail to achieve goals.

b. Regulations apply to those who opt to participate in income support programs.

c. Most states have Right to Farm Laws, which provide some protection to farmers from nuisance lawsuits based on their farming activities (nuisance suits based on common law are possible for other types of pollution activities, Levi and Colyer 1972).

have effects on the location of agricultural production, especially concentrated livestock production such as pork and poultry (Hurt 1994; see Ribaudo et al. 2003, p. 10 for a summary of types of state regulations).

The EPA has become increasingly important since it was founded in the 1970s as the primary agency for handling environmental problems and issues in the United States. As most problems involved with point pollution of water from industrial and municipal sources were solved and it became clear that non-point pollution was the major remaining major water quality problem, agriculture has become a focus as the major contributor to that type of water pollution (Ribaudo 2003; Ribaudo et al. 2003).

The USDA's environmentally related programs have been, and continue to be, primarily voluntary in nature with incentives used to induce farmer participation. These became important during the New Deal era of the 1930s with the founding of the Soil Conservation Service,

although research and educational programs had existed previously with the Cooperative Extension Service and other USDA programs promoting improved farming practices through research and educational programs. The SCS, through cost sharing for soil and water conservation practices, has had important impacts for the environment. These, it might be noted, tended to be positive for competitiveness, as they tended to enhance agricultural productivity.

Changes in farm support programs from price to income support programs in the 1985 Food Security Act, also changed the environmental role of the USDA, since the act required compliance with environmental programs to maintain eligibility for income support payments and made the USDA the enforcement agency (Claassen et al. 2003). The 1985 act had three types of compliance requirements. Under the conservation compliance provision, farmers with highly erodible land were required to comply with basic conservation practices *to remain eligible for support payments*. Sodbuster provisions required that farmers who brought highly erodible land into production comply with stricter conservation practices, i.e., stricter than those already farming such land. The swampbuster portion of the act meant that farmers who converted wetlands to cropland could lose all benefits. These provisions have been continued in agricultural acts subsequent to 1985, including the 2002 act. The acts also have provisions to assist those who chose not to comply due to cost or for other reasons. They could, for example, enroll their land in the Conservation Reserve Program (CRP), i.e., be paid for taking their land out of production. The importance of these provisions is that the government established a set of standards or practices, which used the leverage of the support programs to induce improved practices that would benefit the environment, while not requiring direct additional budget outlays. The government, however, did continue to provide technical assistance needed to enable farmers to comply with the conservation requirements through SCS programs.

The compliance requirements assisted in improving water quality through reduced runoff and erosion from cropland, but had little or no effect on the water quality problems caused by livestock operations and these became subject to more direct regulatory requirements through the EPA and clean water act. However, direct regulatory provisions affect agriculture in a number of areas (Claassen et al. 2001). These include the Coastal Zone Reauthorization Act which includes provisions to reduce non-point runoff from agricultural land in protected coastal waters, the Clean Water Act regulation of dredging and filling of wet lands, the Federal Insecticide, Fungicide, and Rodenticide Act which regulates (and bans some) materials used in agricultural production, and the Endangered Species Act which can affect farming activities in areas where listed species exist, i.e., affects the habitats of species in danger of extinction. In addition, recently developed EPA regulations on handling and disposal of animal wastes from concentrated production units are affecting those operations and their costs (Ribaldo 2003; Ribaldo et al. 2003).

The EPA under the Clean Water Act established requirements for manure handling for concentrated livestock feeding operations (CAFOs), i.e., those with over 1,000 animal units and defined as 2,500 hogs (over 55 pounds), 1,000 beef cattle, 700 dairy cattle, 120,000 broilers, 82,000 laying hens, 55,000 turkeys, 30,000 ducks, 1,000 veal calves, 10,000 sheep and 500 horses—smaller sizes if liquid manure systems are used (EPA 2003). However, as sizes have grown and concentration in some regions increased, the original provisions proved to be inadequate. Consequently, as result of a joint USDA-EPA study and analysis a new set of regulations was developed, and signed by the EPA administrator on December 15, 2002 (EPA 2003; Ribaldo 2003, p. 31). These were published in the Federal Register February 12, 2003 (as a 100-page document) and went into effect April 14, 2003. They are being implemented, will be

in full force in 2006, and will affect many producers—they are mandatory for the large producers and recommended for smaller operations. It should be noted that they apply to the farm unit, the producer, and not to the contractor who often owns the animals and controls the production process. They apply to the distribution of manure on land as well as to the handling of the manure on site, and still involve voluntary aspects. An EPA official is quoted as saying “The goal in regulating concentrated animal feeding operations has been to develop a mix of voluntary approaches and regulation” (quoted in Bury 2003, p. 4).

The distribution of manure on land became a problem with increased concentration that causes excess nutrients to exist in many areas, i.e., more than can be utilized by the plants produced on the land in the area. This is to be handled by requiring that each operation develop and implement a comprehensive nutrient management plan that is “technically sound, economically feasible, and site-specific” (Ribaudó 2003, p. 34). Because land spreading of all manure in the local area is not feasible in some regions and transportation tends to be too expensive, some producers are developing alternative methods of disposing of or, rather, uses for the manure. PerdueAgriRecycle and Harmony Farms Shenandoah Valley (HSV), for example, operate fertilizer plants in Delaware and Virginia, respectively, to convert chicken manure into fertilizer (Ribaudó et al. 2003).

Competitor Environmental Regulation of Agriculture

The U.S. produces and exports many agricultural products and, thus, many countries are competitors. However, the principal ones for the more important agricultural exports in terms of value or volume include the European Union, Canada and, increasingly, Brazil and Argentina. The EU and other industrialized countries tend to have strong environmental programs including regulations affecting agriculture, although like the U.S. and Canada have depended extensively on voluntary and incentive programs (Brethour et al. 2002; Ozanne, Hogan and Colman 2001). As in the U.S. stronger or mandatory requirements are being considered and/or implemented (Brethour et al. 2002; Oskam, Vijftigschild and Graveland 1997). The EU’s environmental regulations, while varying among the member countries, tend to be stronger than in the U.S. (see, e.g., Larson 2002; Metcalfe 2002); the EU, though its parliament, issues directives that member countries are expected to enforce through national legislation, but there is considerable variation from country to country in how the directives are carried out. An example is the nitrate directive, which is to limit the use of products, such as fertilizers and manures that contaminate water. Canada’s regulations are similar to those of the U.S., at least with respect to the costs they impose (Metcalfe 2002). Much of the Canadian regulation is at the provincial level, but tends to be similar among the various provinces (Brethour et al. 2002); as in the U.S. environmental spillovers from concentrated agricultural enterprises has been an inducement toward increased regulation (Mussell and Martin 2000). Brazil and Argentina, as developing countries, have less stringent environmental regulations and are becoming major competitors of the U.S. in agricultural trade, although this is more related to their lower land and labor costs than to their environmental regimes (see Schnepf, Dohlman and Bolling 2001).

Effects of Regulations on Competitiveness

Relatively little research has been carried out on the effect of environmental regulations on the competitiveness of agricultural products in international markets, perhaps because it had

not been an important issue. Environmental regulations have been an important topic in trade and competitiveness for industrial and mineral production since at least the early 1990s, when they were a major concern in the development of the North American Free Trade Agreement and became an issue in the Uruguay Round of the General Agreement on Trade and Tariffs (GATT); they are very important in the current, Doha, round of World Trade Organization (WTO) negotiations (see Huang and Labys, 2002, for a general discussion of the issues, Colyer, 2002, for a discussion of the NAFTA issues, Esty, 1994, for GATT issues and concerns, and ICTSD and IISD 2003 for WTO processes). Gardner (1996, p. 228) in an analysis of environmental regulation and competitiveness of U.S. Agriculture at that time wrote: "To date, the effects of environmental regulation on trade on trends in U.S. productivity and costs have not been significant." Similarly, Krissoff et al. (1996, p. i) state: "The few empirical studies based on these concepts have found many of the linkages between trade and the environment to be weak or the effects small." The revised EPA livestock waste disposal regulations described above, however, have important implications and have induced a spate of publications analyzing their effects or potential impacts on trade, location, costs and allied issues. Gardner, however, viewed the possible impacts of increased regulation as substantial, but thought the political forces for the environment were too weak to be able to produce much stronger legislation, at least in the absence of strong evidence that they would be cost effective.

The increasing evidence of the harmful effects of manure disposal from CAFOs did lead to stronger regulations. Ribardo et al. (2003) examine general aspects and expected impacts of the new regulations as they affect use of manure from CAFOs, as well as smaller animal feeding units. They see important impacts on producer costs and welfare and, to lesser extent, on consumer welfare, but do not analyze the impacts on the international competitiveness of the U.S. livestock industry. The increased costs could, of course, be significant in determining the competitive position of U.S. livestock producers.

Much of the recent work has focused on the pork industry, due largely to some severe environmental problems that have developed in that industry as it became characterized by very large production units and regional concentration of production, although poultry and other concentrated livestock operations also are part of the concerns. This has led to problems in disposal of the manure due to limited land for disposal and to problems such as spills from manure holding facilities resulting from large rains and flooding. Amponsah and Qin (2000, p. 249) in an analysis of the competitiveness of the pork industry, noted that "greater environmental regulation...could increase costs of producing hogs in the United States leading to lower hog production."

Hayenga et al. (1998a) analyzed the competitiveness of the world's major pork exporting countries, specifically the U.S. Canada, Denmark and the Netherlands. While the chapter on the United States (Hayenga et al. 1998b) had a paragraph on environmental concerns (pp. 66-67), the study did not determine the specific impacts of environmental regulations on competitiveness, perhaps because the new EPA rules had not been formulated or, more likely, because these were not considered to be important in determining competitiveness. They did note that the environmental issues and problems are apt to affect the location of pork production in the U.S., with anticipated shifts from areas with current high levels of concentration, North Carolina and Iowa, to "areas like Oklahoma, Utah and Colorado" (p. 67), but did not indicate any effect of environmental regulations on the competitive position of U.S. pork producers, which they see as being influenced positively by the trends in efficiency and quality being

attained by large scale operations (which also are responsible for most of the environmental problems).

Metcalf (2002, p. 227) specifically examined the expected impacts of environmental regulations on the competitiveness of U.S., Canada and the European Union with a mathematical “equilibrium displacement model” which determines changes in expected exports for estimated environmental regulation costs. His findings are that while there are expected increases in costs from environmental regulations in the U.S., these will not harm the country’s competitive position mainly because the EU is expected to impose more costly programs. He states (p. 237), “Although environmental regulation is expected to increase in the U.S., this does not significantly affect the competitiveness of U.S. exports. The relatively more stringent regulations that may be imposed by the European Union actually help to improve the short-run competitiveness of U.S. pork producers.” The cost data used in the study are somewhat hypothetical, but based on existing studies of waste management costs for large producers in the U.S. and European studies of their pork industries—U.S. estimates were used for Canada.

Some recent studies have examined the impacts of environmental regulations on the pork industry, especially on its cost and location in the U.S., without analyzing the effects on international competitiveness, although often recognizing that they do have international implications (Kaplan and Johansson 2003; Leuck and Zering 2003). Major conclusions are that costs are increased with those being affected by the types of manure management systems used as well as by the availability of land for disposing of the manure in an environmentally friendly way. Leuck and Zering, for example, find that manure handling costs amount to 2.6 percent of cost of a marketed hog in North Carolina and 1.2 percent in Iowa, levels that could certainly be a factor in international competitiveness. They also note that manure handling savings help account for increased pork production in the western areas of the U.S. and Canada and that there are economies of scale in some manure management systems. Kaplan and Johansson have similar findings, but also note that the USDA can help fund improvements in manure handling systems through its Environmental Quality Incentive Program (EQIP). Ribaudo et al. (2003) indicate that these are sufficient to offset the costs in many of the scenarios they examined. Adhikari, Harsh and Cheney’s (2003) analysis concludes that environmental compliance costs have minimal effects on location of production within the United States.

Although hypothetical, Gray, Harper and Highmore (2001) analyzed the effects of applying a Pigovian tax on hog production to offset the costs of greenhouse gas emissions by that enterprise. They estimate the costs to be \$50 per ton of pork meat produced, base the tax on that figure, and use a trade simulation model to determine the effects under different assumptions about which countries implement the tax. If it is worldwide, the effects are minimal with a small reduction in total production, 1.5 percent with \$50 tax and 3.0 percent for a \$100 per ton tax. However, if only the industrialized countries impose the tax, the changes are profound with large reductions in those countries, but with a nearly complete offset by China and the rest of the world and practically no reduction in greenhouse gas emissions.

The literature, while not conclusive, indicates that the costs of environmental regulations are generally relatively small and do not tend to be significant in terms of competitiveness, a conclusion reached earlier by Krissoff et al. (1996). Despite this, they can be significant and can be a factor in the location of production and, hence, international competitiveness. One factor that tends to mitigate the effects, at least in industrialized countries with strong research capabilities, is the tendency to develop innovations that minimize the costs of regulation (see Krissoff et al. 1996; Porter and van de Linde 2002; Ribaudo et al. 2003). The current work, as

during the 1990s (see Gardner 1996) is largely aimed at estimating the potential impacts of the regulations on costs, location, and/or competitiveness. Little work has been done to analyze the actual impacts, a situation that is not possible for the current regulations since they have not yet had time to produce significant effects. However, the complexities of the real world make it difficult to separate the effects of changes in environmental regulations from those that occur for other reasons.

Green Subsidies and Non-Tariff Barriers

The cost of domestic environmental regulations is not the only environmentally related factor that can affect competitiveness. Two other relatively common practices can be important in determining the competitive position of agricultural producers. These are subsidies for environmental goods or practices, generally termed green payments, and non-tariff barriers based on environmental factors, which can take a wide variety of forms from outright bans on the imports of non-complying goods, increased costs of meeting the required conditions and certifications, or something as simple as labeling for source or characteristics. Green payments are common in the EU, while the U.S. has assisted farmers through cost sharing of conservation practices since the 1930s when the SCS was established. Such payments are exempt from the limits on domestic subsidies developed for the Agreement on Agriculture (AoA) during the Uruguay Round of the GATT, an exemption that would continue under many of the proposals made for the current, Doha, round of WTO negotiations (Cooper, Peters and Claassen 2003). Many developing countries, however, view these as just another way that the industrialized nations subsidize their agriculture in ways that are detrimental to the agriculture of the third world (Devadoss 2002; Hoekman and Anderson 2000). The U.S. program was not developed to affect competitiveness, but it none-the-less has impacts on the ability to export commodities through both reductions in costs to farmers as well as enhancing the productivity of the agricultural resource base. The EU and Japan, however, have far more extensive programs and have complicated WTO negotiations through the concept of multifunctionality of agriculture, which includes more than just agricultural production and protecting the environment (see Paarlberg, Bredahl and Lee 2002; Peterson, Boisvert, and de Gorter 2002).

There was a failed attempt to extend the scope of conservation payments to U.S. farmers when the farm act was up for renewal in 2002 through a proposed Conservation Security Act, which would have shifted a substantial part of agricultural income support to a more broadly based system of conservation payments. Lohr (2001) argued that this was essential for the development and competitiveness of the organic food sector in the U.S. because the EU subsidizes its organic farmers. Organic farming has grown much faster in the EU and comprises a larger share of agriculture than in the U.S., 2.9 percent compared with only 0.2 percent in the U.S. Lohr (2001 p. 4) concludes, "The superior competitive position held by EU organic farmers is due to direct agri-environmental payments and cannot be overcome through pure market mechanisms." The U.S. Congress, however, decided to stay with the existing programs which heavily subsidize conventional grain producers, a situation that some analysts and most developing countries consider to result in the dumping of grain by the U.S., i.e., the selling of grain at below the cost of production (see, e.g., Ritchie, Murphy and Lake, 2003). However, while these also affect competitiveness, they are not environmental subsidies.

Many nations impose non-tariff barriers (NTBs) on trade for a variety of reasons and, while the AoA from the Uruguay Round required tariffication of most of the non-tariff barriers

to trade in agricultural goods, many NTBs still exist under various provisions of the GATT/WTO agreements, such as Article XX, or are utilized despite being prohibited. A U.S. report (USTR 2003a) on foreign trade barriers has a non-exhaustive list of more than fifty countries plus the EU and Arab League that have NTBs affecting U.S. exports, most with one of more NTBs that constrain agricultural and food exports. The most common ones affecting agriculture are sanitary/phytosanitary provisions designed to protect human, animal and plant health (see, e.g., Rosson 1998). These are legitimate if (1) they are based on science and (2) apply equally to domestic and all foreign producers. Thus, the U.S., for example, requires certification that an area is free of particular pests or diseases for the area (country) to export citrus or some other fruits, vegetables, melons, etc. that are also produced in the U.S. The purpose is to prevent the introduction of pests or diseases that would devastate domestic production. Thus, everyone banned the import of beef from England at the time of the mad cow disease outbreak, and the U.S. recently banned imports of beef from Canada after one diseased cow was found in a herd. Sometimes, however, such provisions might be used as a way to protect domestic producers, a situation that is difficult to determine (Beghin, Bureau and Park 2003; O'Conner 2003). See Colyer (2000) for examples of sanitary/phytosanitary provisions that affect poultry trade.

Purely environmental concerns are sometimes treated in a similar way, i.e., through import bans for products produced in ways not considered to be environmentally sound, with characteristics thought to be environmentally harmful, or as a way to protect endangered species. Again, under Title XX of the GATT agreement exceptions to the rules prohibiting trade barriers are allowed for the protection of human, animal and plant health and life, but the interpretation of this provision is open to question and its use by an individual country is controversial. The U.S. bans on imports of tuna not caught in a dolphin safe manner and of shrimp not caught in ways to protect sea turtles are examples of the use non-tariff barriers for environmental reasons. These domestic regulations were protested through the GATT system with the U.S. losing an appeal in the tuna case but winning, partially, in the shrimp case (see Colyer 2002; Eglin 1999, Esty 1994). The EU ban on imports of beef fed with hormone feed additives and its virtual ban, through a moratorium and labeling requirements, on food from genetically modified organisms are similar provisions with, at least for the latter, environmental reasons or implications—part of the reason is a fear that native species might cross with the GMO—although the main reason seems to be health concerns. It is not known if long term problems might result from consuming such products; although there is no science to support the claim that they are harmful the EU invokes the precautionary principle as a justification, since there is no proof that such foods are either safe or harmful from a long-run perspective. In addition, the EU has NTBs that affect U.S. poultry exports (processors use a weak chlorine solution to wash poultry and the EU does not permit this), animal byproducts from animals not intended for human consumption, certain by products from cattle sheep and goats due to mad cow disease fears, some gelatin products, and triple super phosphate which does not meet EU solubility requirements (USTR 2003a). Similarly Brazil and Argentina have NTBs that prohibit U.S. poultry and other exports, as do a large number of countries. Thus, such bans can be effective means to overcome the comparative advantage that foreign producers might have. The U.S. has protested the EU moratorium on GMOs and filed a complaint with the WTO, claiming that it is an illegal restraint on trade (USTR 2003b). Clemens and Babcock (2002) document the difficulty of U.S. beef producers who want to export non-hormone treated beef to the EU. The costs and difficulty in obtaining certification make it nearly impossible for the U.S. to compete, and a once profitable market has

been lost. Taylor, DeVuyst and Koo (2003) examine the effects of GMO bans on the potential exports of U.S. wheat and find that, unless a good system of identity is implemented to keep GMO and non-GMO wheat separate, U.S. exports will suffer.

Certification and/or labeling of products as to origin or characteristics, such as organic or dolphin safe, are approaches that can act either as trade barriers or trade promoters. A label as a GMO food is probably a barrier to trade since, at least in the EU, such foods are considered inferior; there are virtually no GMO foods on grocery shelves in the EU since it is believed that consumers would not purchase them (see Carter and Guerre 2003). In July 2003, the European parliament passed stronger legislation requiring labeling and tracability of GMO foods, to become effective early in 2004, if approved by the 15 member states (Alvarez 2003; ICTSD 2003). U.S. officials and producer groups have criticized the requirements and the U.S. is threatening to file a dispute about this with the WTO.

However, the label 'organically grown' could promote trade since many people prefer and are willing to pay a premium for such products (see Lohr 2000; Rodriguez and Epperson 2001). Although there is no science that proves they are superior products, perceptions are important. Eco-labeling is becoming an important aspect in the environmental area and has potential for both improving the environment and enhancing international trade (see, for example, Athearn 2003; Dawkins 1996; Dobbs et al. 2003; van Ravenswaay and Blend 1997). As for other approaches, eco-labeling is controversial and may be viewed as a way to help the environment or as a trade barrier; Dawkins (1996, p. 4), for example, concludes: "By definition, ecolabeling imparts preferential access...Such discrimination may conflict with GATT's Most-Favoured Nation rules and certainly generates new competitive pressures among producers."

Conclusions

The costs of environmental regulations tend to be relatively small for most agricultural products. None-the-less, they can be critical factors in the competitiveness of a product since the cost advantages of producers in one country are often very slim. Thus, additional costs derived from new regulations can be critical in determining the continued importance of exports and of the maintaining or increasing a nation's share of the international market. Governments, however, often try to assist their industries in overcoming the disadvantages caused by such added cost through subsidies, tax breaks, technical assistance or in other ways. In agriculture these are increasingly taking the form of green payments, which are currently exempt from the limits imposed on domestic subsidies permitted for agriculture—the U.S. and EU have largely avoided the impacts of such limits by having set them high enough to avoid immediate problems and then converting their subsidies to indirect forms, i.e., to subsidies not tied to current production levels. In addition to these mechanisms for addressing the environment, there also has been a selective but subversive process of erecting non-tariff barriers based on environmental protection issues. It is often difficult to determine if such measures are really for protecting the environment or for protecting domestic producers. They are, none-the-less, generally effective approaches for achieving environmental objectives and can also be effective measures to alter competitiveness.

Competitiveness can be either enhanced or diminished by the environmental regimes of competing nations. The existence of negative externalities means that prices are lower than would prevail if all costs were included in the prices of the products. This is a form of environmental subsidization and can give an advantage to the country with less strict

environmental regulations. However, when regulations are revised to internalize such costs, the country imposing the regulations can have its competitive edge reduced or eliminated.

Historically, agriculture tended to be exempted from regulations, including environmental regulations, but with a greater emphasis of environmental issues and problems this has changed to some degree, especially in the more industrialized countries of the world. Agricultural producers are now faced with increased regulation with its consequent negative impacts on costs and competitiveness. However, this is often mitigated through green payments or other forms of subsidies that enable agriculture to remain competitive in export markets. The U.S. and EU have revised their subsidy schemes to allow them to continue to make large payments to farmers through the blue and green boxes of the WTO Agreement on Agriculture. This is especially important as the use of export subsidies is increasingly being limited. It is, however, a sophistry to assume that the indirect (income support) subsidies do not distort agricultural prices and trade. This is, non-the-less, the position advocated by both the United States and European Union.

References

- Adhikari, B.B., S.B. Harsh and L.M. Cheney. "Factors Affecting Regional Shifts in U.S. Pork Production." Paper presented at the annual meeting of the American Agricultural Economics Association, Montreal, July 27-30, 2003.
- Alvarez, Lizette. "Europe Acts to Require Labeling of Genetically Altered Food." *New York Times*, July 2, 2003 (<http://www.newyorktimes.com/2003.../03FOOD.html>).
- Amponsah, W.A. and X.D. Qin. "Pork," in D. Colyer, P.L. Kennedy, W.A. Amponsah, S. M. Fletcher, and C.M. Jolly, eds. *Competition in Agriculture: The United States in the World Market*. Binghamton, NY: The Haworth Press, Inc. 2000.
- Athearn, K.R. "Can Eco-Labeling do More Harm Than Good? A Comparative Statics Analysis." Paper Presented at the Southern Agricultural Economics Association Meeting, Mobile, AL, February 1-5. 2003.
- Batie, S.S. "Green Payments as Foreshadowed by EQIP." Staff Paper 99-45, Department of Agricultural Economics, Michigan State University, July 1998.
- Beghin, J.C., J-C Bureau and S.J. Park. "Food Security and Agricultural Protection in South Korea." *American Journal of Agricultural Economics* 85:3(2003):618-632.
- Bhagwati, J. "Trade and the Environment: Exploring the Critical Linkages," in M.E. Bredahl, N. Ballenger, J.C. Dunmore and T.L. Roe, eds. *Agriculture, Trade, and the Environment: Discovering and Measuring Critical Linkages*. Boulder, CO: Westview Press, 1996.
- Brethour, C., P. MacGowan, A. Mussell and H. Mayer. "Proposed New Environmental Legislation Affecting Canadian Agriculture." George Morris Centre. January 2002.
- Bromley, D.W. "The Environmental Implications of Agriculture." Staff Paper Series No. 401, University of Wisconsin, Agriculture and Applied Economics, October 1996.
- Bury, S. "Waste or Wasted Opportunity?" *Trio: The Newsletter of the North American Commission for Environmental Cooperation*, Summer 2003 (<http://www.cec.org/trio/stories/index.cfm?varlan=english&ed=10&ID=123>).
- Carson, R. *Silent Spring*. New York: Houghton Mifflin Company, 1962.
- Carter, C.A. and G.P. Gruere. "International Approaches to the Labeling of Genetically Modified Foods." *Choices* (2nd Quarter 2003)(<http://www.choicesmagazine.org/current/2003-2-02htm>).

- Charnovitz, S. "Solving the Production and Processing Methods (PPM) Puzzle." in S.P. Gallagher and J. Werksman, eds. *The Earthscan Reader on International Trade and Sustainable Development*. London: Earthscan Publications, Ltd., 2002.
- Claassen, R., L. Hansen, M. Peters, V. Breneman, M. Weinberg, A. Cattaneo, P. Feather, D. Gadsby, D. Hellerstein, J. Hopkins, P. Johnston, M. Morehart, and M. Smith. *Agri-Environmental Policy at the Crossroads: Guideposts on a Changing Landscape*, AER Report No. 794, Washington: Economic Research Service, U.S. Department of Agriculture, 2001.
- Clemens, R. and B.A. Babcock. "Why Can't U.S. Beef Compete in the European Union?" MATRIC Briefing Paper 02-MBP 4, Midwest Agribusiness Trade and Information Research Center, Iowa State University, Ames, November 2002.
- Colyer, D. "Poultry," in D. Colyer, P.L. Kennedy, W.A. Amponsah, S. M. Fletcher, and C.M. Jolly, eds. *Competition in Agriculture: The United States in the World Market*. Binghamton, NY: The Haworth Press, Inc. 2000.
- Colyer, D. "Environmental Considerations in the FTAA and Other Trade Liberalization Agreements." Paper presented at the S-287 Conference on the FTAA, WTO and New Farm Legislation, San Antonio, TX, May 22-24, 2002.
- Cooper, J., M. Peters and R. Claassen. "Effects of Agri-Environmental Payment Policies on Agricultural Trade." Paper presented at the Annual Meeting of the American Agricultural Economics Association, Montreal, July 27-30, 2003.
- Dawkins, K. "Ecolabeling: Consumers' Right-to-Know or Restrictive Business Practice?" GETS Paper #95-3, Institute for Agriculture and Trade Policy (<http://www.gets.org>), Jan 1996.
- Devadoss, S. "Domestic Support and WTO Negotiations from Developing Countries' Perspectives." Paper presented at the Western Agricultural Economics Association Annual Meeting, Long Beach, CA, July 28-31, 2002 (<http://agecon.lib.umin.edu>).
- Dobbs, T., G. Nguyen, S.K. Bertramsen, and B. Legagneux. "French Quality and Eco-Labeling Schemes: Do They Also Benefit the Environment." Paper presented at the American Agricultural Economics Association Annual Meeting, Toronto, Canada, July 27-30, 2003.
- Eglin, R. "Trade and Environment," in J. Bhagwati and M. Hirsch, eds. *The Uruguay Round and Beyond: Essays in Honor of Arthur Dunkel*. Ann Arbor: The University of Michigan Press, 1999.
- Esty, D.C. *Greening the GATT: Trade, Environment and the Future*. Washington: Institute for International Economics, 1994.
- Esty, D.C. and M.E. Porter. "Ranking National Environmental Regulation and Performance: A Leading Indicator of Future Competitiveness?" in M.E. Porter, J.D. Sachs, P.K. Cornelius, J.W. McAuthur, and K. Schwab, eds. *The Global Competitiveness Report 2001-2002*. Oxford: Oxford University Press, 2002.
- Evans, E.A. "Economic Dimensions of Invasive Species." *Choices* (2nd Quarter 2003), http://www.choicesmagazine.org/current/2003-2-02_htm.
- Gardner, B.L. "Environmental Regulation and the Competitiveness of U.S. Agriculture," in M.E. Bredahl, N. Ballenger, J.C. Dunmore and T.L. Roe, eds. *Agriculture, Trade, and the Environment: Discovering and Measuring Critical Linkages*. Boulder, CO: Westview Press, 1996.

- Gray, R., D. Harper and T. Highmore. "Greenhouse Gas Policies and the International Competitiveness of the Hog Industry." Paper presented at the International Trade Research Consortium Annual Meeting, Auckland, New Zealand, January 2001.
- Hayenga, M.L., et al. "Global Competitiveness of the U.S. Pork Sector." Staff Paper 301, Department of Economics, Iowa State University, Ames, pp. 53-70, 1998a.
- Hayenga, M.L., D. Seim, J. Lawrence and R. Clemens. "The United States Pork Industry: Factors Influencing Export Market Competitive Position," in M.L. Hayenga et al. "Global Competitiveness of the U.S. Pork Sector." Staff Paper 301, Department of Economics, Iowa State University, Ames, 1998b.
- Hoekman, B. and K. Anderson. "Developing Country Agriculture and the New Trade Agenda." *Economic Development and Cultural Change* 49(October 2000): 171-180. Hoekman, B. and K. Anderson. "Developing Country Agriculture and the New Trade Agenda." *Economic Development and Cultural Change* 49(October 2000): 171-180.
- Huang, H. and W.C. Labys. "Environment and Trade: A Review of Issues and Methods." *International Journal of Global Environmental Issues* 2:1/2:(2002):100-160.
- Hudson, D., D. Hite, A. Jaafar, and F. Kari. "Environmental Regulation Through Trade: The Case of Shrimp." *Journal of Environmental Management* 68:3(2003): 231-238.
- Hurt, C. "Industrialization in the Pork Industry." *Choices* Fall Quarter, 1994 (reprinted in H. Ayer, ed. *The Best of Choices: 1986-1996*. Ames, IA: American Agricultural Economics Association, 1996).
- International Centre for Trade and Sustainable Development (ICTSD) and International Institute for Sustainable Development (IISD). "Doha Round Briefing Series: Trade and Environment." <http://www.ictsd.org/pubs/dohabriefings/index.htm>, February 2003.
- International Centre for Trade and Sustainable Development (ICTSD), "European Parliament Adopts Bioetech Regulations on Traceability and Labeling." *Bridges Weekly Trade News Digest* 7:24(2003):4 (<http://www.ictsd.org>).
- Josling, T., M. Honma, J. Lee, D. McLaren, B. Miner, S. Sumner, S. Tangermann, and A. Valdes. "The Uruguay Round Agreement on Agriculture: An Evaluation." IATRC Commissioned Paper No. 9. International Agricultural Trade Research Consortium, 1994.
- Kaplan, J.D. and R.C. Johansson. "When!%\$? Hits the Land: Implications for US Agriculture and Environment when Land Application of Manure is Constrained." Paper presented at the Annual Meeting of the American Agricultural Economics Association, Montreal, Canada, July 27-30, 2003.
- Krissoff, B., N. Ballenger, J. Dunmore, and D. Gray. *Exploring Linkages Among Agriculture, Trade and the Environment: Issues for the Next Century*. Agricultural Economic Report No. 738, Washington: U.S. Department of Agriculture, May 1996.
- Larson, B.A. "European Union Environmental Policies and Imports of Agricultural Products from the United States." Paper presented at the American Agricultural Economics Association annual meeting, Long Beach, CA, July 2002.
- Leuck, D. and K. Zering. "Manure Handling Costs and the Competitiveness of Pork Production." Paper presented at the Annual Meeting of the Southern Agricultural Economics Association, Mobile, Alabama, February 1-5, 2003.
- Levi, D.R. and D. Colyer. "Legal Remedies for Pollution Abatement." *Science* 175(10 March 1972): 1085-87.

- Lohr, L. "The Importance of the Conservation Security Act to US Competitiveness in Global Organic Markets." FS 01-19, Department of Agricultural and Applied Economics, University of Georgia, Athens, GA, November 2001.
- Lohr, L. "Factors Affecting International Demand and Trade in Organic Food Products." FS 00-20, Department of Agricultural and Applied Economics, University of Georgia, Athens, GA, November 2000.
- Metcalfe, Marc R. "Environmental Regulation and Implications for Competitiveness in International Pork Trade." *Journal of Agricultural and Resource Economics* 27:1(2002): 222-243.
- Mussell, A. and L. Martin. "Manure as a Public Health Issue: What Accountability and Direction for Livestock Agriculture." Special Report, The George Morris Centre, June 2000.
- O'Connor, B. "Food Safety, the SPS Agreement and EPA Negotiations." *Trade Negotiations Insights: From Doha to Cotonou* 2:2(April 2003):1-2, 5, 7.
- Oskam, A.J., R.A.N. Vijftigschild, and C. Graveland. "Additional EU Policy Instruments for Plant Protection Products." Final Report, Mansholt Institute, Wageningen University, August 29, 1997.
- Ozanne, A., T. Hogan and D. Coleman. "Moral Hazard, Risk Aversion and Compliance Monitoring in Agri-Environmental Policy." *European Review of Agricultural Economics* 28:3(2001):329-347.
- Paarlberg, P.L., M. Bredahl and J.G. Lee. "Multifunctionality and Agricultural Trade Negotiations." *Review of Agricultural Economics* 24:2(2002):322-335.
- Peterson, J. M., R. N. Boisvert, and H. De Gorter. "Multifunctionality and Optimal Environmental Policies for Agriculture in an Open Economy." in M.D. Ingco, ed. *Agriculture, Trade, and the WTO: Creating a Trading Environment for Development*. Washington: World Bank, pp. 165-191, October 2002.
- Porter, M.E. and C. van de Linde. "Toward a New Conception of the Environment-Competitiveness Relationship." in S.P. Gallagher and J. Werksman, eds. *The Earthscan Reader on International Trade and Sustainable Development*. London: Earthscan Publications, Ltd., 2002.
- Ribaudo, M. "Managing Manure: New Clean Water Act Regulation Create Imperative for Livestock Producers." *Amber Waves* 1:1(2003)30-37 (www.ers.usda.gov/abmberwaves).
- Ribaudo, M., J. Kaplan, L. Christensen, N. Collehon, R. Johansson, V. Breneman, M. Aillery, J. Agapoff, and M. Peters. *Manure Management for Water Quality: Costs to Animal Feeding Operations of Applying Manure Nutrients to Land*. Agricultural Economics Report Number 824, Washington: Economics Research Service, U.S. Department of Agriculture, June 2003.
- Ritchie, M., S. Murphy and M.B. Lake. "United States Dumping on World Agricultural Markets," Cancun Series Paper 1. Minneapolis, MN: Institute for Agricultural Trade and Policy (www.iatp.org, accessed March 2003).
- Rodriguez, D. and J.E. Epperson. "The Latin American Organic Coffee Industry: U.S. Market Inroads." FS 01-16, Department of Agricultural and Applied Economics, University of Georgia, Athens, September 2001.
- Rosson, P. "Estimating and Reducing Technical Barriers to Trade." CNAS 98-3, Center for North American Studies, Texas A & M University, October 1998.

- Schnepf, R.D., R. Dohlman and C. Bolling. *Agriculture in Brazil and Argentina: Developments and Prospect for Major Field Crops*. ERS Agriculture and Trade Report WRS013, Washington: US Department of Agriculture, December 2001.
- Srivastava, J.P. and H. Alderman. *Agriculture and Environmental Challenges: Proceedings of the Thirteenth Agricultural Sector Symposium*. Washington: The World Bank, 1993.
- Taylor, R.D., E.A. DeVuyst and W.W. Koo. "Potential Impacts of GM Wheat on United States and Northern Plains Wheat Trade." *Center of Agricultural Policy and Trade Studies Newsletter* 3:3(May 2003):2-3.
- Tilman, D., J. Fargione, B. Wolff, C. D'Antonio, A. Dobson, R. Howarth, D. Schindler, W.H. Schlesinger, D. Semberloff and D. Swackhamer. "Forecasting Agriculturally Driven Global Change." *Science* 292(13 April 2001): 281-284.
- U.S. Environmental Protection Agency (EPA). "National Pollutant Discharge Elimination System Permit Regulation and Effluent Limitations Guidelines and Standards for Concentrated Animal Feeding Operations (CAFOs)—Final Rule." *Federal Register*, February 12, 2003, pp. 7176-727, available online (<http://cfpub.epa.gov/npdes/afo/cafofinalrule.cfm>).
- U.S. Trade Representative (USTR). "2003 National Trade Estimates Report on Foreign Trade Barriers." (<http://www.ustr.gov/reports/nte/2003/index.htm>), 2003a.
- U.S. Trade Representative (USTR). "U.S. and Cooperating Countries File WTO Case Against EU Moratorium on Biotech Foods and Crops." Washington, May 13, 2003b.
- van Ravenswaay, E.O. and J.R. Blend. "Using Eco-Labeling to Encourage Adoption of Innovative Environmental Technologies in Agriculture." Staff Paper No. 97-19, Department of Agricultural Economics, Michigan State University, June 1997.
- Warman, T. "1996 Farm Bill: A Triumph for Conservation." *American Farmland: The Magazine of the American Farmland Trust* Spring (1996):6-8.
- Zilberman, D. and M. Marra. "Agricultural Externalities," in G.A. Carlson, D. Zilberman and J.A. Miranowski, eds, *Agricultural and Environmental Resource Economics*. Oxford: Oxford University Press, pp. 221-267.