International Agricultural Trade and Policy Center

Economic Issues of Invasive Pests and Diseases and Food Safety

By

E. A. Evans, T. H. Spreen, and J. L. Knapp

MGTC 02-2 **December 2002**

MONOGRAPH SERIES

UNIVERSITY OF FLORIDA

Institute of Food and Agricultural Sciences

INTERNATIONAL AGRICULTURAL TRADE

AND POLICY CENTER

MISSION AND SCOPE: The International Agricultural Trade and Policy Center (IATPC) was established in 1990 in the Food and Resource Economics Department (FRED) of the Institute of Food and Agricultural Sciences (IFAS) at the University of Florida. Its mission is to provide information, education, and research directed to immediate and long-term enhancement and sustainability of international trade and natural resource use. Its scope includes not only trade and related policy issues, but also agricultural, rural, resource, environmental, food, state, national and international policies, regulations, and issues that influence trade and development.

OBJECTIVES:

The Center's objectives are to:

- Serve as a university-wide focal point and resource base for research on international agricultural trade and trade policy issues
- Facilitate dissemination of agricultural trade related research results and publications
- Encourage interaction between researchers, business and industry groups, state and federal agencies, and policymakers in the examination and discussion of agricultural trade policy questions
- Provide support to initiatives that enable a better understanding of trade and policy issues that impact the competitiveness of Florida and southeastern agriculture specialty crops and livestock in the U.S. and international markets

Abstract: The problem of invasive pests and diseases has become more urgent and far more complex today than in the recent past. Increased trade and movement of people, and the opening up of new trade routes have increased opportunities for the spread of invasive species. In addition, mono-cropping systems of cultivation; globalization; increased resistance of pests to pesticides and food safety and environmental concerns have all contributed to the growing complexity of the problem on hand.

The economic dimensions of the problem can be viewed from at least two perspectives. First, with regard to the spread and impact of invasive species, particularly how best to provide more comprehensive assessments of impacts of invasions, so as to improve the cost effectiveness and efficiency of publicly funded programs aimed at eradication, control or mitigation of invasive pests and diseases. Second, from the perspective of incorporating more economic analysis and use of economic instruments in designing sanitary and phytosanitary measures.

The paper explores some of these issues from an economic perspective. It concludes that incorporating more economic analysis in matters related to biological invasions is desirable, but presents a challenge to economists. Measurement requires data, and success in measurement will require that economists and biological scientists work closer together than they have in the past.

Key words: sanitary and phytosanitary measures; SPS; invasive species; WTO; economic impacts of invasive species

ECONOMIC ISSUES OF INVASIVE PESTS AND DISEASES AND FOOD SAFETY

E. A. Evans, T. H. Spreen and J. L. Knapp

The problem of invasive (non-indigenous) species is not new but has intensified in recent years to become a serious challenge facing mankind in this era of globalized trade (FAO, Economist). “Animals, plants, and microbes can now migrate across the planet to new homes with unprecedented ease” (Economist, pp.118). The increased spread of invasive species is tied to the rapid pace of globalization and trade liberalization, which have resulted in more and faster trade and more opportunities for long-distance hitch hiking by invasive species. The increased trade in fresh commodities (particularly horticultural products, floricultural products, live animals and raw animal products) and increased international travel and trading have increased the risks associated with the spread of pests and diseases. In addition, they add to the concerns associated with enforcing quarantine, increased smuggling, food safety and the effects of pesticides and other control methods on the environment (FAO).

The economic dimensions of the problem of invasive species can be viewed from at least two perspectives. First, there is recognition that central to the problem of biological invasiveness is economics and that the consequences of such invasions go far beyond the direct damages or control costs. Invasive species can cause biodiversity loss, ecosystem degradation and aesthetic changes (Eiswerth and Johnson). Hence, economics can assist with: a) providing more accurate and comprehensive assessments of the costs of these incursions so that the cost effectiveness and efficiency of publicly funded programs aimed at eradication, control or mitigation of invasive pests and diseases can be better determined; and b) investigating the relationship between the spread and impact of invasive species, and economic variables such as the extent of openness of a country's economy, composition of its trade flows, tourism flow, and rate of growth, with a view to influencing policy decisions (Perrings et al.; Eiswerth and Johnson.).

Second, there is the concern of quantifying and modeling the economic and trade impacts of technical trade barriers. Common among such barriers are sanitary and phytosanitary (SPS) measures, trade restrictions imposed by a country in an attempt to prevent entry of invasive species. The specific concern is that while such measures are within the rights of a country and often can be justified on the grounds of economic and social prosperity they can also impose unnecessary social costs, thwart commercial opportunities, and reduce competitions and economic growth. Given the dual nature of such measures, there is the need to find new ways to apply the principles and tools of economics to the science of invasive species so that improved policies can be designed in society's interest. The challenge is how best to incorporate economic analysis and economic instruments in the design of SPS policies to ensure that the benefits of the measures enacted exceed their costs (James and Anderson; Orden; Roberts et al.; Spreen et al.).

The purpose of this paper is to further explore some of the issues related to invasive pests and diseases from an economic perspective. We begin by providing some evidence of the social and economic importance of invasive species in terms of the costs imposed on society. This is followed by an examination of the various components comprising the economic impacts of invasive pests and diseases. The case of citrus canker in the United States (in particular Florida) is used to illustrate the extent and nature of the impacts. Next, we briefly discussed the economic rationale for interventions by governments in the matter of preventing or controlling the spread of invasives. In doing so, we define the economic concepts of a public good and an externality. We then turn attention to developments within the World Trade Organization (WTO) and in particular, to the Agreement on the Application of Sanitary and Phytosanitary Measures. The major tenets of the Agreement are then discussed, along with some of the arguments advanced for and against the incorporation of more economic analysis in designing such regulatory policies. The paper concludes with brief remarks on the issues of the economics of invasiveness.

Socio-Economic Importance of Invasive Pests and Diseases

While there are many studies of the costs and benefits of programs for the control of particular weeds, pests, and pathogens programs, only two have attempted to assess the aggregate cost of invasive species at the national level (Perrings et al). These studies were conducted by the US Office of Technology Assessment (OTA), and by Pimentel et al. The US OTA study estimated damage costs from 79 harmful species and found that it had cost the US a cumulative total of about US$97 billion over a 85-year period or an annual estimated cost of $1.14 billion per year. The study by Pimentel et al. assessed the magnitude of the environmental impacts and the economic costs of all invasive species in the United States. The authors found that the cost of damages amounted to approximately $137 billion per annum with the main groups of contributors being Microbes (30.1%), Mammals (27.2%), Plants (25.0%) and Arthropods (15.4 %). They explained the sizeable gap between their estimates and that of US OTA ($1 billion compared to $137 billion per annum) as being due in part to their wider coverage (10 times the number of species considered by the former) and higher costs of treatments (Pimental, et al.). But, as

Perrings pointed out, these estimates are still likely to underestimate the problem since they only dealt with a subset of the impacts of invasive species. For example, although the brown tree snake had been responsible for the extinction of dozens of bird and lizard species in Guam, the full extent of the costs of such damages have not been estimated and were not included in the study.

Information obtained from the Florida Department of Agriculture and Consumer Services (Table 1) on the impact of selected pests and diseases provides additional evidence of the burden that can be imposed on a country or region due to invasive pests and diseases. The information in Table 1 reveals that between FY 1995/96 and FY 2001/02, the state of Florida spent a total of $531.6 million dollars on efforts to eradicate and control selected invasive pests and diseases. It was further estimated that an additional $887.5 million has been lost by the industry over the same period due to sales losses associated with invasive pests and diseases. Of this amount, the citrus industry has been hit the hardest due to the presence (although not endemic) of citrus canker, which has resulted in estimated sale losses of $775.00 million.

Although most of the diseases listed in Table 1 are not endemic, projections carried out by the Florida Department of Agriculture and Consumer Services indicate that

Table 1. Estimated Statewide Impacts of Selected Invasive Pests and Diseases for Period FY 1996-2002, ($ millions)

Selected Invasive Pests and Diseases	**State Costs for Control/ Eradication**	**USDA/Federal Costs for Control/ Eradication**	**University of Florida Costs for Research**	**Industry Costs for Control**	**Five-Year Industry Sales Loss**	**Annual Potential Sales Loss with Statewide Spread**
Citrus Canker	141.03	146.70	4.00	29.00	775.00	375-750
Medfly	24.35	26.20				
Thrips Palmi*			2.40	20.00		3.5
Brown Citrus Aphid*	0.23		1.7	30.0		5.2
Citrus Leafminer			0.60	32.00		5.5
Oriental Fruit Fly	0.26	0.28				
Sweet Potato Whitefly*			3.00	22.00		
Pine Shoot Beetle	.01				56.25	
Leatherlear Fern Anthracnose*	0.78		0.70	33.0	56.25	15-20

Selected Invasive Pests and Diseases	State Costs for Control/ Eradication	USDA/Federal Costs for Control/ Eradication	University of Florida Costs for Research	Industry Costs for Control	Five-Year Industry Sales Loss	Annual Potential Sales Loss with Statewide Spread
Equine Piroplasmosis	0.04					120
Heartwater Disease	1.12		5.30			195
Tropical Soda Apple*	1.24		2.20			
Tomato Yellowleaf Curl			0.28	0.75		
Total	**169.06**	**173.1**	**22.7**	**166.75**	**887.5**	**719.20 – 1.10**
Total Costs for Eradication, Control	**531.61**					

* No eradication possible after introduction

Source: Florida Department of Agriculture and Consumer Services; Florida Citrus Commission; Florida Tomato Exchange; Florida Fresh Fruit and Vegetable Association; University of Florida/Institute of Food and Agricultural Sciences.

if these pests and diseases were to spread statewide, the total cost to the State could easily exceed one billion annually. Moreover, these estimates do not include some of the secondary and indirect multiplier effects and most of the social and environmental costs, which are usually difficult to measure in the market, for example, the values that a homeowner attached to backyard trees and any disruption of ecosystems.

Assessing the Economic Consequences of Invasive Pests and Diseases

As mentioned earlier, economists are increasingly trying to assess the current status and economic significance of the problem of invasive species. Considerable effort is being devoted to assessing the full economic impacts of invasive pests and diseases so that effective management programs to help prevent, control or mitigate such invasions can be developed. Previously, the focus was simply on identifying the most cost effective means of treatment in the case of an outbreak. Now, the emphasis has shifted to obtaining information on the benefits and costs of treatment with a view to determining how best to manage the particular pest and/or disease (FAO). Economists are employing such tools as dynamic optimization and ex-ante analysis to assist decision makers (Jetters et al.; Eiswerth and Johnson). However, assessing the impacts is imprecise because the full range of economic costs of biological invasions goes beyond the immediate impacts on the affected agricultural producers. Often included are secondary and tertiary effects such as shifts in consumer demands, changes in the relative prices of inputs, loss of important biodiversity and other natural resource and environmental amenities.

Bigsby suggests that the range of economic impacts can be broadly classified into two categories, direct and indirect impacts. He viewed the direct effects as the impacts of the particular pest or disease on the host, and indirect impacts as non-host specific effects.

The latter would be the general effects that are created by the presence of a pest, but not specific to the pest-host dynamics and could include effects such as public health issues; the compromising of key ecosystem functions; general market effects, including possible changes in consumers attitude toward a given product; research requirements; market access problem; and impacts on tourism and other sectors of an economy.

Also, FAO has identified the following six types of impacts: (1) production; (2) price and market effects; (3) trade; (4) food security and nutrition; (5) human health and the environment; and (6) financial costs impacts.

Production Impacts—These are considered to be the most direct economic impacts and are associated with the host resulting in the loss or reduced efficiency of agricultural production such as yield decline. Even though such impacts may be relatively easy to identify, they can be difficult to measure. Disease can have lasting effects on the host in ways that are not obvious. In livestock, for example, there could be delays in reproduction, resulting in fewer offspring. The pesticides applied to treat a given pest could pollute soil and surface water. Also, it might be difficult to separate the impacts of the pests from other impacts such as climate.

Price and Market Impacts—Outbreaks of pests and diseases have the potential to effect changes in the market, by directly affecting the quantities of a commodity demanded or supplied. The exact impact on the market and the duration of the impact depends on a number of factors, including the nature of the pests and diseases, the size of the domestic markets, and the relative elasticities of demand and supply. In cases where consumer health is involved as in the recent outbreak of bovine spongiform encephalopahy (BSE), both consumer perceptions about an implicated product and the ability of a country to produce safe food after an outbreak or illness are usually slow to recover and can have a lasting influence on food demand and global trade (Buzby, Food Safety Agency).

In addition to the above, an indirect way in which invasive pests and diseases could impact the market is by affecting the relative pricing of inputs used in the production of a commodity. The effects could be upstream and downstream. For example, a consequence of a particular outbreak could be a change in the demand for farm labor or in the demand for other services or goods needed for the production and marketing of the affected and/or unaffected commodities, thus creating downstream and upstream effects.

Trade Impacts—The introduction and/or spread of invasive species can have major trade implications which could outweigh the direct production losses. Such trade impacts will depend on a number of factors, including the policy response of partner trading countries to news of the outbreak, the importance of traded commodities, the extent of the damage caused, and the set of demand and supply elasticities. An important concern is the prospect of losing competitive advantage in an export market and possibly the premium that was gained with the ability to supply disease-free products. Such concerns are real since the typical response of countries that are free of the particular pests will be to either prohibit entry of the commodities from the affected country or establish a set of precautionary measures. Whether there is complete prohibition or the need to follow a set of procedures, the competitive advantage that a country might have previously enjoyed could be lost.

Food Security and Nutrition impacts—The extent to which invasive pests and diseases either reduce the domestic supply of foods directly or restrict the country's ability to exports and in turn purchase food from abroad, could have a negative impact on a country's food security. This impact could be a serious concern for developing countries.

Human Health and the Environment/Impacts—Assessing the human health impacts of invasive pests and diseases is difficult since, in many cases the impacts are not fully understood. The available evidence does suggest, however, that the incidence of invasive zoonotic and parasitic diseases and related food-borne diseases is growing and that their health and socio-economic impacts are increasingly being felt in both developed and developing countries.

Invasive pest species can be extremely damaging to native crops because natural predators and parasites that keep them in balance in the native land are usually not present in the new environment. Thus it is possible for an invasive species not to be a pest in its native land, but to cause significant damage in the new environment, which, in the extreme, could lead to the loss of biodiversity[1]. Invasive species also have the potential to adversely affect important environmental service flows such as cropping systems, livestock grazing, recreational uses and can infest and clog rivers, irrigation systems, and shorelines with dire consequences. In addition, they can have a negative impact on ecological service flows, that is, services provided by one resource for other resources or an entire ecological system (Eiswerth and Johnson).

[1] See paper by Eiswerth and Johnson for a discussion on some of the ways that invasive species can adversely impact the enviroment.

Financial Costs Impacts—Measures taken at the individual, collective and international levels to control, eradicate, or mitigate invasive pests and diseases have budgetary implications. Such costs could include, the costs of inspections, monitoring, prevention, and response. However, one can also view the lost revenues resulting from decline in productivity of the enterprise as part of the financial cost impacts. Table 2 summarizes the above impacts as they relate to the recent outbreak of citrus canker in Florida.

Estimation of these economic impacts requires a considerable amount of biological and non-biological information that involves considerable time and expense. An unresolved issue facing economists therefore is agreeing on the scope of the economic analysis. In other words, what should constitute an appropriate measure of the economic effects? Most studies done to date have restricted estimates of the impact of invasive pests and diseases to those that can easily be calculated (such as costs of control, eradication and prevention and the expected loss in productivity of the enterprise). However, there is growing concern among economists (FAO, Bigsby; Perrings et al.) that such an approach is shortsighted since, in several cases, the indirect effects arising from (say) the trade impacts could easily outweigh the production loss impacts. On the other hand, measuring some of these other effects (e.g., on the environment) can be expensive and time consuming. Although there has been a greater appreciation of some of the environmental impacts associated with invasive species, valuing such non-market effects can be quite challenging. Economists are attempting to get around that problem with the use of methods such as "contingent valuation" and "willingness to pay to obtain or avoid similar benefits or losses."

Table 2. Summary of Potential Impacts of Citrus Canker in the State of Florida

Type of Impact	**Possible Effects**	**Remarks**
Production	• Yield reductions	• Due to die-back, fruit drop, and tree eradication..
Price and Market	• Impact on fresh market prices unambiguous	• Depends on the severity of the outbreak, size of domestic market, and the extent to which supplies can be sourced from other states or countries. • Expect initial decrease in price, resulting from a drop in demand for the fresh produce (due to perception of possible inoculums transmission on the fresh fruit), and increases in quantities available locally because of export restrictions. Over time, it is expected that price should increase with the higher costs of production and gradual recovery in quantity demanded).

Type of Impact	Possible Effects	Remarks
	• Impact on the processed market unambiguous	• Expect that initially there will be a decrease in price as the supply of citrus juices increases due to an increase in quantities of fresh product that would now go to the processors. • Impact will be felt more on the fresh than on the processed market.
Trade	• Impact depends on policy responses of importing countries • Potential loss of competitive advantage and price premiums in the international market for	• Typical reaction of many countries is to ban the importation of citrus stocks and fresh fruits from affected regions. • Interstate and international commerce account for about 20% of Florida's $9 billion commercial citrus

Type of Impact	Possible Effects	Remarks
	exporting disease-free citrus products • Severe curtailment of interstate and international commerce of fresh citrus fruit	industry.
Food Security and Nutrition	• No major impacts	
Human Health and Environment	• Psychological impacts • Possible landscape and aesthetic impacts	• Can be manifested in shock and panic • Landscape values decline when trees are removed
Financial	• Loss of income due to any, or a combination, of the following: – Yield reductions – Poor fruit quality	• Apart from the direct impact of citrus canker on productivity, secondary yield loss might come about as a result of the treatment employed to combat the disease. For example, there may be loss of fruit due

Type of Impact	Possible Effects	Remarks
	– Possible reduction in market price due to loss of external markets and oversupply of local markets – Sales loss due to tree eradication. • Increased cost of production due to: – Costs of replanting trees – Other management costs, including cost of spraying; capital investments in new equipment; cost of planting windbreaks; surveillance; and other management schemes	to the citrus trees removed to plant wind breaks or shading of tree rows adjacent to windbreaks. • Infected fruits are less valuable or unmarketable. • Infected trees must be removed, land must remain fallow for two years, and replacement trees take at least 11 years to reach original productivity levels. • In most cases trees have to be replanted with resistant stocks that are more expensive. • Could affect the competitiveness of the industry.

Type of Impact	Possible Effects	Remarks
	to maintain yields – Compliance costs, including inspection for fresh export certification, and sanitation costs for grove sites, harvesting, packing houses, and juice processing plants • Cost of eradication program, including: – Costs to physically remove the trees – Compensation to homeowners and commercial producers – Legal fees • Possible upstream and downstream effects	• Although the disease might not be endemic, a set of guidelines might have to be followed to satisfy local, foreign, SPS regulatory authorities. • Government might have to compensate home owners and commercial growers for trees destroyed • Some homeowners might challenge the decision to cut down infected backyard trees. • The citrus industry is interrelated with many other upstream and downstream agribusinesses such as

Type of Impact	Possible Effects	Remarks
		processors, packinghouses, and input suppliers. A reduction in the demand for fresh products, for example could adversely affect packinghouses, causing a wave of secondary and tertiary effects (multiplier effects).

Compiled by authors based on information obtained from several sources, including Muraro et al. and Jetter et al.

A more general problem that affects computation of these impacts is the general unavailability of data, especially in cases where there is no past experience on which to base the analysis and there is only the threat of introducing the pests and diseases. Apart from the unavailability in some cases of economic parameters such as demand, supply, import and export elasticities, complications usually arise due to the uncertainty of the scientific evidence with regard to issues such as the probability of entry and establishment, rate of spread and the extent of damage. Closer collaboration between economists and biological scientists as well as with the increased availability of computer software programs such as the Excel @RISK program that combines simulation procedures with probability distribution, are making it possible for analysts to combine actual, but limited data with theoretical modeling in determining potential impacts.

The preceding discussions suggest the following. First, estimating the social and economic costs of invasive pests is indeed difficult and imprecise. Second, notwithstanding the fact that a large number of invasive species have been beneficial and have contributed to our food supply, those identified as pests can have major social and economic implications, in terms of the private and public costs of outbreaks as well as the potential for loss of valuable biodiversity. And, third there is ample justification for countries/regions to be concerned about the spread of invasive pests and diseases and to want to adopt measures to restrict the threat of danger from the spread of invasive pests and diseases.

Economic Rationale for Governments to Become Involved

The rationale for governments to become involved in establishing policies and implementing measures to prevent or control the introduction and spread of invasive pests and diseases can be found in the economic concepts of public goods and externalities.[2] In general, a public good is one in which it is virtually impossible to prevent anyone from consuming it, but consumption by one person does not in anyway limit consumption by another person. Since no one can take ownership, it is necessary for the government to assume the responsibility of providing such goods and recoup the costs by means such as taxation. Examples of public goods include national defense, basic research and, in this case, measures aimed at preventing or controlling the spread of invasive pests and diseases. The concept of a public good can easily be extended to global public goods when there is cooperation among governments of many countries to take action to reduce, say, the threat of invasive pests and diseases.

An externality arises when the action or inaction of one party affects another party in a positive or negative manner but the effect is not taken into account by the party that carried out the action. Negative externality may arise, for example, when imported goods are accompanied by invasive pests or diseases that may reduce domestic output and/or increase production costs. If the market mechanisms alone fail to prevent or correct such negative externalities, then governments are justified in providing regulations (public goods) that will prevent entry or reduce the risks of the threat.

The need for a government to protect its citizens and environment against imported externalities (such as invasive pests and diseases) is recognized and embraced

[2] Most micro economic text book discuss these concepts

by the WTO Agreement (discussed below), which promotes increased trade among countries. When legitimate externalities or other market failures are addressed through measures (technical trade barriers) to restrict trade, for instance, in a commodity with the potential to introduce disruptive pests and diseases, they have the potential to increase national welfare. However, when such measures are imposed for the sole purpose of isolating domestic producers from international competition, they are welfare-decreasing policies. Moreover, even in legitimate cases it is possible that measures could be imposed that are sub-optimal, leading to a reduction in net social benefits. As noted earlier, it is this dual nature of the SPS measures – having on the one hand the potential to provide externality-based protection while on the other hand a potential to be used for economic-based protection – that have provided an added reason why economists are showing greater interest in the issue of invasive pests and diseases.

The Uruguay Round Sanitary and Phytosanitary Agreement

The decision to negotiate separate disciplines for SPS measures (Agreement on the Application of Sanitary and Phytosanitary Measures) during the 1986-1994 Uruguay Round multilateral trade negotiations marked a turning point in the development of multilateral trade rules and gave prominence to issues related to agricultural trade and the risk of importing invasive pests and diseases and food-borne illnesses. Although SPS measures were recognized as having the potential to impede trade and considered important under previous GATT rounds, they were relegated to being included as parts of other agreements and as exceptions to the main provisions fostering increased trade.[3]

[3] SPS measures were found in the original GATT Articles, mainly Article XX (General Exceptions) and later in the 1979 Tokyo Round Agreement on Technical Barriers to Trade (a pluri-lateral agreement known as the Standards Code).

The impetus for negotiating a separate Agreement for SPS measures and bringing to the forefront quarantine issues can be attributed in general to the deeper integration of agriculture into the international trading system, based on market openness and free trade and in particular, the decision to discipline the use of quantifiable non-tariff trade barriers (such as quotas, subsidies, and licenses). Many countries, including the US, feared that with a reduction in the use and levels of these support measures, some importing countries might turn to technical trade barriers (notably SPS measures) as a means of allowing them to continue providing support to their farming community. Consequently, the intent of the Agreement was to ensure that when SPS measures were applied, they were used only to the extent necessary to ensure food safety and animal and plant health, and not to unduly restrict market access for other countries (James and Anderson; Josling; Roberts).

Main Provisions of SPS Agreements

To achieve its objectives, the SPS Agreement contains a set of substantial and procedural provisions. The substantive procedures are aimed at protecting human, animal and plant health and life while preventing unjustifiable barriers to trade. The procedural provisions set up a framework that improves communication between members regarding any proposed changes in their SPS measures and provides a forum for dispute settlement. The main substantial provisions can be found in Article 5 and include the following:

– Article 5.1, requires members (when possible and as appropriate) to base their *SPS measures on risk assessment methodologies* developed under the auspices of the appropriate relevant international organization.

– Article 5.2 stipulates that countries should consider *direct risk-related costs (e.g., potential production or sales losses or control and eradication costs)* both in assessing risks and managing risks through the choice of an SPS measure to protect plant or animal health.

– Article 5.5 states that each member is also obligated to avoid arbitrary or unjustifiable distinctions in the levels of protection it considers to be appropriate (if these distinctions would result in a disguised restrictions on international trade) in order to achieve the objective of consistency in the application of SPS measures.

Article 6 requires that import protocols be based on risk assessments that evaluate the claims by exporting countries that certain regions are free of quarantine diseases or pests, or that the prevalence of quarantine pests and disease is low.

Safer Trade versus Freer Trade

The view among several economists is that the SPS Agreement, by obliging its members to base SPS measures on risk assessments grounded in science and to adopt (where possible) the standards promulgated by international organizations[4], is a step in the right direction towards preventing the unjustified use of such measures. They argue however, that implementation of the measures is still largely subjective and is based on "value judgments in scientific assessments of risks" (Roberts;). According to Roberts, the risk assessment paradigm, as set out in the Agreement, requires that the agency responsible for carrying out the risk assessment identifies a set of measures that

[4] For plant health, members are encouraged to adopt the standards developed by the Secretariat of the International Plant Protection Convention, and for animal health and zoonoses the standards developed by the International Office of Epizootics.

would achieve an "acceptable level of risk" and that the policymaker chooses from among such measures. Roberts contends that this approach “embeds value judgments in scientific assessments of the risks and may encourage myopic focus on only the risk-related costs of the measures”. In order words, the approach as it now stands does not clearly specify how a country, after having done the risk assessment, should go about determining what is an “appropriate level of risk”. She contrasted this approach to one that is based on an economic paradigm, where the objective would be to determine “the appropriate levels of protection using economic welfare analysis tools to systematically analyze the benefits as well as the costs (including the risks related costs) of different regulatory options.”

The latter approach suggests that the decision to adopt a particular measure (in the case where there is the potential to import invasive pests and diseases) would be based on the following: a) an assessment of risk (probability) of introducing a particular pest or disease; b) an assessment of the potential trade and welfare impacts based on the probability of introduction and establishment of the particular pests and diseases; and 3) a choice made on the basis of an overall objective of maximizing welfare through minimizing negative trade impacts, i.e., a final decision that is based on an assessment of different management options that seek to minimize the risks and/or expected economic consequences associated with the import of a risky product. This approach suggests that there should be a trade-off between the economic welfare gains associated with importing a risky product and the expected economic losses. Economic welfare analysis, therefore provides a basis for assessing the net and distributional impacts among economic outcomes arising from such regulatory decisions. Models used can evaluate current as well as proposed measures, furnishing important information that policymakers can take into account in designing policies that realize their goals at the lowest cost to consumers, producers, and the international trading system. For example, adopting a system approach[5] may be less costly to society than an outright prohibition of importing the commodity. Likewise, investing in the infected exporting country to ensure that the necessary hazard and critical control points are established to prevent the likely spread and export of the pests and diseases could be more beneficial to society as a whole.

Among the advantages cited of adopting a welfare-based approach is the potential to improve global welfare by allowing for more efficient uses of global resources and limiting the extent to which unnecessary social costs are imposed on society. A more fundamental advantage is the greater degree of transparency and consistency in applying SPS measures that the approach would allow. Countries would have in place an objective basis on which to justify that the measures implemented are not protectionist or discriminatory (Roberts et al. James and Anderson).

As a consequence, economists (Krissoff et al.; Josling; Spreen et al.; Sumner and Lee; Orden; Roberts et al.) have been busy trying to develop a framework for assessing the trade and welfare implications of trading a particular commodity under different management options when there is the potential for introduction of an invasive pest or disease. Developing such a framework, however, is far easier in theory than in practice. For one thing, the involvement of externalities in the form of unwanted pests and diseases, and specifically the risks and uncertainty associated with them, complicates the

[5] A system approach is a set of safeguard and mitigating measures designed to individually and cumulatively reduce plant pest risk (Jetter)

standard economic policy analysis (MacLaren, 1997). Likewise, as pointed out by Spreen et al. the measurement of the likely impact of imposing SPS restrictions on consumers and producers is tied directly to the quality of economic models. And, that although the theoretical tools used to analyze the impact of restrictions on aggregate consumption and supply and equilibrium price are well-developed, the empirical measurement of these effects is an inexact science.

Roberts et al., have separately developed methodologies that can be used to quantify the quarantine measures in the presence of risks and uncertainty. As to be expected, the authors have indicated that operationalizing their frameworks is not straightforward and requires a substantial amount of information. They identify at least five sets of questions that need to be answered in assessing the impact of potential technical trade barriers. These include: a) the question of the nature of the technical trade barrier, specifically whether it relates to plant and animal health, food safety or conservation; b) determining the policy instruments that are used and then translating such instruments into variables; equations and constraints in economic models; c) computing the effect that implementation (or non-implementation) of the regulations would have on the conditions of supply or demand (or both) as well as cost of compliance; and d) determining the relative position of the particular exporters and importers in the market place, for example, whether the regulations apply to all exporters or whether they apply only to a particular exporter; and e)determining the structure of the market in which the goods are sold.

Attempts to incorporate more economics principles and methods into the SPS decision-making process have not gone without criticisms. Those who oppose it base their argument on the premise that "freer trade" (implied by the welfare maximization approach) is not necessarily compatible with "safer trade" (implied by the current SPS agreement). They further suggest that the latter approach should at all times take precedence over the former. Specifically, the argument advanced is that when it comes to matters of national safety with regard to the possibility of importing invasive pests and diseases, the benefits of prevention will always outweigh the benefits derived from gains of trade. This argument is based on the typical "an ounce of prevention is better than a pound of cure" and the "precautionary principle".[6] The vulnerability of the food system in the wake of the September 11, 2001 attack and incidence of West Nile virus provide further justification. In addition, it is felt that introducing additional economics into the decision-making process would unduly complicate the process and require expensive analysis. Also, the view has been expressed that, given the increased concern about pesticides and the resulting reduction in the number and types available it has become much more difficult to combat outbreaks of pests, so it is best to take all the precautions necessary to avoid any such introduction.

A general counter to the above arguments has been that all economic activities involve a certain degree of risks and no system can be foolproof; hence the objective of zero risks is untenable. Moreover, it has been argued that steps can be taken to simplify the process of incorporating more economics into the decision-making process.

Concluding Remarks

The problem of invasive pests and diseases has become more urgent and far more complex today than in the recent past. Increased trade and movement of people, and the

[6] The precautionary principle dictates that when the consequences of a rare event are large, the safest path should be taken and the risky activity should not be permitted at all is SPS measures are determined based

opening up of new trade routes have increased opportunities for the spread of invasive species. In addition, mono-cropping systems of cultivation; globalization; increased resistant of pests to pesticides; and food safety and environmental concerns which have restricted the amount and types of pesticides that can be used to combat such invasions, have all contributed to the growing complexity of the problem on hand.

Economists have begun to show greater interest in the problem of invasiveness from two points of views. First, they are trying to develop a better understanding the relationships between the spread and impact invasive species and a set of economic variables, so as to provide more comprehensive assessments of impacts of invasions, as well as improving the cost effectiveness and efficiency of publicly funded programs aimed at eradication, control or mitigation of invasive pests and diseases. Second, economists have sought to incorporate more economic analysis and economic instruments in designing measures to restrict entry of particular pests and diseases.

Economic welfare analysis provides a basis for assessing the net and distributional impacts among economic outcomes arising from such regulatory decisions. Models used can evaluate current as well as proposed measures, furnishing important information that policymakers can take into account in designing policies that realize their goals at the lowest cost to consumers, producers, and the international trading system.

However, as discussed, incorporating more economic analysis in dealing with the issues of biological invasions is easier in theory than in practice. Measurement requires data and success in measurement will require that economists and biological scientists work closer together than they have in the past.

---

on the view that practically no risk is acceptable.

References

______ *The Economist*. 2000. “New flora and fauna for old” December 23, pp. 118-119.

Bigsby, H. 1995. Estimating the economic impacts of pest introduction, market effects and partial equilibrium analysis. AERU report for the Ministry of Agriculture and Fisheries, Wellington, New Zealand.

Bigsby, H. and C. Whyte. 2001. “Quantifying phytosanitary barriers to trade” In *Interdisciplinary Food Safety Research* edited by N.Hooker and E. Murano. New York:CRC Press.

Buzby, J.C. 2001. “Effects of food-safety perceptions on food demand and global trade” In *Changing Structure of Global Food Consumption and Trade.*WRS-01-1, Economic Research Service, USDA, Washington D.C..

Eiswerth, M., and W. Johnson. (in press). “Managing Non-indigenous Invasive Species: Insights from Dynamic Analysis.” *Environmental and Resource Economics*.

Food and Agricultural Organization (FAO). 2001. *The State of Food and Agriculture* 2001, Rome. <http://www.fao.org/docrep/003/x9800e/x9800e14.htm>.

Food Safety Agency. 2000. Review of BSE control. Final report. United Kingdom.

James, S., and K. Anderson. 1998. "On the need for more economics assessment of quarantine policies. "Australian Journal of Agricultural and Resource Economics", 42:4 pp. 425-444.

Jetter, K., E. Civerolo, and D. Sumner. 2002. "Ex-Ante Economics of Exotic Disease Policy: Citrus Canker in California" in D. Sumner Exotic Pests and Diseases: Biology, Economics, Public Policy. Agricultural Issues Center, University of California, Davis, CA.

Josling, T. (2002). "Can one make the SPS Agreement work for small economies?" Paper presented at the 24 West Indies Agricultural Economics Conference, Grenada West Indies. July 9-12.

Krissoff, B., L. Calvin, and D. Gray. 1997. "Barriers to Trade in Global Apple Markets," *Fruit and Tree Nuts Situation and Outlook*, FTS-280, Econ. Res. Serv., U.S. Dept. Agr., August.

MacLaren, D. 1997. "Uncertainty aversion and technical barriers to trade : An Australian example." In Orden, D. and Roberts, D. (eds.) Understanding Technical Barriers to Agricultural Trade, University of Minnesota's Department of Applied Economics for the International Agricultural Trade Research Consortium, St. Paul, pp. 251-71.

Muraro, R. P., F. Roka, T. Spreen, 2000. An Overview of Argentina's citrus canker control program with applicable costs for a similar program in Florida. In: Proceedings of the International Citrus Canker Research Workshop, Ft. Pierce FL, June 20-22. Online. Diveision of Plant Industry, Florida Department of Agriculture and Consumer Services.

Orden, D., C. Narrod and J. Glauber. 2001. "Least trade-restrictive SPS policies: an analytic framework is there but questions remains." In Kym Anderson, Cheryl McRae and David Wilson (eds.) Adelaide: Center for International Economic Studies.

Perrings C., M. Williamson, E. Barbier, D. Delfino, S. Dalmazzone, J. Shogren, P. Simmons, and A. Watkinson. 2002. Biological invasion risks and the public good: An economic perspective. *Conservation Ecology* 6(1): 1 http://www.consecol.org/vol6/iss1/art1

Pimentel D., L. Lach, R. Zuniga, D. Morrison. 1999. Environmental and economic costs associated with non-indigenous species in the United States. College of Agriculture and Life Science, Ithaca, NY., Cornell University, Ithaca, N.Y.

Roberts, D. 1998. Implementation of the WTO Agreement on the Application of Sanitaryand Phytosanitary Measures. Economic Research Service/ USDA. Agriculture in the WTO/WRS-98-44. Washington D.C.

Roberts, D., T. Josling, D. Orden, 1999. *A Framework for Analyzing Technical Trade Barriers in Agricultural Markets.* Market and Trade Economics Division, Economic Research Service, U.S. Department of Agriculture. Technical Bulletin No. 1876. Washington D.C.

Spreen, T. H., J. J. VanSickle and C. Brewster. 2001. "Trade Distortions in a Free Trade Zone : The Case of Sanitary and Phytosanitary Barriers." *In Trade Liberation and Globalization of World Agricultural Markets.*Charles B. Moss, Gordon Rausser, Andrew Schimitz, Timothy Taylor, and David Zilberman (eds.) Norwell MA:Kluwer Academic Publishers.

Sumner, D., and H. Lee. 1997. "Sanitary and Phytosanitary Trade Barriers and Empirical Trade Modeling," in *Understanding Technical Barriers to Agricultural Trade*, Proceedings of a Conference of the International Agricultural Trade Research Consortium(IATRC), David Orden and Donna Roberts (eds.) IATRC:St Paul, MN, January.

US OTA 1993. Harmful non-indigenous species in the United States. Washington D.C. : Office of Technology Assessment, United States Congress.