# AGRICULTURE, TRADE AND THE ENVIRONMENT: ANTICIPATING THE POLICY CHALLENGES

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**ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT**

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**PUBLISHER'S NOTE**
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## FOREWORD

This report was prepared by Professor David Ervin of the Henry A. Wallace Institute, Washington, United States of America, for discussion in the Joint Working Party of the Committee for Agriculture and the Environment Policy Committee.

This document is made available to the public as a consultant's report. The opinions expressed and the arguments employed in this document are the sole responsibility of the author and do not necessarily reflect those of the Committee for Agriculture and the Environment Policy Committee or of the governments of OECD Member countries.

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# AGRICULTURE, TRADE AND THE ENVIRONMENT: ANTICIPATING THE POLICY CHALLENGES

## I. Executive summary

In principle, trade liberalisation and environmental management are reinforcing. But the simultaneous achievement of these twin socio-economic goals in practice requires trade and environmental policies that complement each other. Evidence presented in this report indicates that neither the agricultural trade nor the environmental policies in OECD countries generally measure up to the complementary standard. Specific problems have already surfaced, and broader conflicts lie in the future. Waiting until the conflicts emerge and deepen to improve policy threatens significant losses to trade and to the environment.

Available evidence on agricultural trade and environmental management sets the context. Agricultural trade liberalisation may not cause large short-term degradation or improvement in the global environment. The overall shifts in production and income are small for most countries and the adjustments will occur gradually. Domestic agricultural policy reform ameliorates some production distortions that often exacerbate environmental problems, but promises only modest effects and does not remedy the root causes of incomplete markets.

Despite the small short-term environmental risks, problems linked to trade expansion may grow in the absence of accompanying policies. For example, new pathways for invasive foreign pests that damage indigenous flora and fauna may be opened. Environmental quality may be especially vulnerable to concentrated production increases in some areas, as along trade border zones. Other regions may experience large decreases in production leading to land abandonment which may diminish environmental amenities in some countries. Still other countries may view the withdrawal of land from production as providing wildlife habitat or other benefits which attests to the importance of considering the specific preferences for environmental services by particular countries. The same concerns may extend beyond OECD country borders to developing countries that respond to new trading opportunities and higher prices. If environmental resources in those countries hold value for OECD countries, such as biodiversity conservation, international action will be required.

Assessments of the effects of agriculture's current environmental programmes on trade also indicate small overall effects. Agroenvironmental programmes in OECD nations have generally used voluntary, subsidy approaches with little effect on production costs and trade competitiveness. There is some evidence to suggest that land set-aside and certain chemical regulation may be exceptions. The voluntary-payment approach contrasts with the non-agricultural industries that experience more regulation and higher compliance costs.

Three major questions guide the report's analysis to anticipate key policy issues:

- **Will economic growth from liberalised trade stimulate effective environmental policies?** Income growth from trade liberalisation is one of the factors raising public demand for remedial environmental policies. However, the full treatment of significant environmental problems, in particular, transboundary and global environmental problems, with effects spread over multiple countries, such as air pollution and biodiversity conservation, may not be covered. Thus, liberalised trade is a necessary but not sufficient step to ensure complete environmental accounting. Indeed, if agroenvironmental policy fails to account for significant costs and benefits, national and international, trade liberalisation can not be judged welfare enhancing a priori. Internalisation of significant environmental effects, both negative and positive, in production and trade decisions is necessary.

- **Will future agroenvironmental management programmes inhibit trade?** Although current policies may not exert large effects, impacts may be aggravated in the future. Maintaining large set-aside programmes constrains trade when environmental objectives can be achieved while retaining land in profitable production. Agricultural policy reform accompanying the Uruguay Round Agreement (URA) will reduce production subsidies and therefore the rationale for using the set-aside as means of production control. Increased reliance on command-and-control regulations to restrict agrichemical pollution may also affect trade in some cases. Targeting remedial programmes to significant problems to maximise the efficacy of subsidies or minimise compliance costs will reduce long-term risks to competitiveness, and so will enhanced investment to discover low-cost (or profitable) management practices that meet environmental performance standards. Present policies in most countries do neither as a rule.

- **Can the trade and environmental benefits of environmental trade measures be balanced?** Perhaps the largest cloud on the horizon hangs over environmental trade measures (ETMs) that can become non-tariff barriers. Legitimate purposes exist for the measures, such as controlling the entry of harmful nonindigenous species. Surveys show that ETMs in agriculture are not pervasive, but they may grow to serve environmental and trade purposes. Current rules and precedent do not fully cover the application of ETMs that jointly serve environmental and agricultural trade goals. Global and regional trade bodies should be supported in actively developing policies that ameliorate such problems before they create a crisis.

Answers to the questions above depend crucially on domestic and international policies that promote trade liberalisation yet ensure significant environmental costs and benefits are counted in private and public decisions. Four policy challenges emerge from the analysis:

- Continued reform of agricultural policies that cause trade distortions and exacerbate environmental problems.

- Reform of agroenvironmental policies to rely less on broad subsidies and set asides, and more on targeted, low-cost approaches that where appropriate retain land in production.

- Clarify and further develop international rules pertaining to the application of ETMs.

- Develop institutions to manage transboundary and global environmental resources affected by agricultural trade liberalisation.

Co-operation between OECD countries to build environmental indicators, inventory management programmes and assemble agroenvironmental science will foster better understanding and mutual assurance among trading partners and help avert conflicts. Extending that co-operation to the study of rules for ETMs and management institutions for transboundary and global environmental challenges would be a wise precautionary investment.

## II. Basic questions about agricultural trade and the environment

Two powerful global trends - liberalised trade and environmental protection - are pulling and pushing agriculture with no signs of abatement. Will the trends conflict and restrict trade expansion and environmental progress, or will they complement each other, allowing more trade and better environmental quality? The answer to that fundamental question depends critically on the nature of agricultural, trade and environmental policies. OECD countries are struggling not only to develop national policies consistent with the trends, but increasingly are drawn into a complex and ever-growing web of international policy.

Conflicts in simultaneously pursuing expanded trade and environmental improvement are often portrayed. However, in principle, trade liberalisation and proper environmental management may reinforce each other, since both are required to maximise welfare [Anderson, 1992; Bhagwati; Sinner]. Both ensure that private decisions are guided by full potential benefits and costs, whether trade or environmental. OECD policy recognises this interdependency: "Provided that effective environmental policies (including cost internalisation ) are implemented, trade liberalisation will contribute to sustainable development by improving the efficient allocation of resources, promoting economic growth and increasing general welfare [OECD,1996]. But in practice, neither complete trade liberalisation nor full environmental accounting exist, and trade and environmental policy continue on separate, perhaps diverging, paths with the likelihood of greater conflict that will limit one or both objectives.

Expanded trade is a key growth sector for agriculture in many OECD countries. It may be an even more important force in the development of non-OECD countries as they respond to opening markets from trade liberalisation. Environmental policies using unnecessary trade restrictions could hamper growth in both settings. The URA, which will remove many non-tariff barriers (NTBs), could prompt the use of such environmental measures for market protection [Runge, 1990]. Because the effects of NTBs may not be apparent for some time, efforts to preempt them could spare the costly process of reform once they are instituted.

Environmental risks may appear from any production expansion fostered by trade liberalisation. By virtue of its large land and water requirements, agriculture uses and affects a greater share of most nations' natural resources than any other industry. Its production processes inevitably alter natural vegetative cover, apply fertilisers and pesticides, use irrigation water, and generate animal wastes. The risks may not be immediately perceived because of the diffuse nature and time lags involved in much agricultural pollution, such as accumulating nutrients and pesticides in drinking waters. Moreover, the degradation of some natural resources may reach critical zones beyond which the effects can not be remediated, as with the extinction of species of flora and fauna. Early attention to such long-term risks could lower future costs and lessen the chances of trade restrictions.

The second chapter reviews the major issues surrounding agricultural trade liberalisation and environmental protection. Then three central questions are examined to seek answers that are central to developing harmonised agricultural trade and environmental protection policies:

- **Will economic growth from liberalised trade stimulate effective environmental policies?** - Economic growth from trade liberalisation raises national income which, together

with other factors (e.g. cultural influences, the media, interest groups, etc.), lifts the demand for environmental quality. Although that growth process often generates pollution, it eventually stimulates remedial environmental policy as described in the third chapter. But will the induced policies cover all significant environmental costs and benefits?

- **Will future agroenvironmental management programmes inhibit trade?** - Agriculture's environmental (agroenvironmental) policies rely mostly on subsidy approaches, which were sanctioned in the URA if they satisfy certain conditions. Unless they are cost-effective, expanded subsidies, especially for land set-aside, will distort agricultural trade. Similarly, expanded chemical regulations may threaten trade, unless they are based on the best scientific evidence regarding human and environmental health risks. The fear of lost trade is compounded if competing exporters are perceived to implement less stringent environmental protections thus creating an uneven trade playing field. The fourth chapter examines the effects of agroenvironmental programmes.

- **Can the trade and environmental benefits of environmental trade measures be balanced?** - The challenge is to design policies that achieve social environmental objectives at least cost to trade and to domestic producers and consumers. The balancing of trade gains with environmental risks carried with imports is a key issue to the policy design process. Devising social and scientific criteria to evaluate import-related measures that reduce environmental risks will reduce, their use as unwanted nontariff barriers. However, such criteria require difficult multilateral co-operation as has occurred for food safety under sanitary and phytosanitary rules. The issues surrounding the use of ETMs in agriculture are explored in the fifth chapter.

This report develops the conceptual linkages underlying each question, and then examines available evidence. A major objective of the paper is to identify key policy challenges to simultaneously achieving agricultural trade liberalisation and effective agroenvironmental management. Emerging policy issues at the national and international levels are outlined in the closing chapter.

Before exploring agricultural trade and environmental linkages, the scope of the term "environment" requires brief comment. In this analysis, it refers to the *natural environment* comprised of physical and biological assets that provide productive or consumptive uses for people, or hold intrinsic value just by their existence. Soil, water, forests, minerals, air and wildlife illustrate natural environmental resources. Food safety concerns such as pesticide residues that affect human health directly but do not have a natural environment linkage do not fall within this definition. Thus trade measures regulating food safety will only be dealt with as they have environmental sources or consequences. This is an arbitrary distinction because humans are obviously part of the earth's biosphere, but the management of human risks and benefits of trade involve a different set of issues and institutions beyond the scope of this paper.

## III. Overview of trade and environment linkages

### *1. Liberalised agricultural trade causes uneven environmental effects*

Growing evidence links a diversity of negative and positive environmental situations to agriculture. A recent U.S. assessment revealed widespread remaining problems and opportunities for improvement despite significant progress over the last decade [OTA, 1995b]. Water quality topped the list of problems, while large gains have been made in wildlife habitat and soil erosion control. In the Netherlands, livestock manure causes serious ammonia emissions and heavy metals pollution. Intensive

dairies in New Zealand cause poor stream conditions. Australia confronts land degradation from salinization due to irrigation. Traditional haymaking and extensive grazing help conserve much of Sweden's biodiversity in plants, flowers, birds and insects. Japan considers rice farming to provide valuable rural landscape and other benefits. How will trade liberalisation and accompanying domestic agricultural policy reform affect such a broad range of environmental situations?

World trade in agricultural products has been on a steep trajectory since 1970, jumping fivefold to more than $200 billion [USDA,FAS]. Liberalised trading rules approved in the URA and numerous regional trade liberalisation pacts will continue to propel the expansion. The new trading rules should increase the volume of international agricultural commerce, create new trade pathways that heretofore have been unexplored, and shift regional production patterns. Although most attention has been focused on the impact of production shifts, each response can affect environmental quality.

As for all trade flows, the possible environmental effects from an increased volume of food and fibre trade stem firstly from pollution caused by more international transport. Most transboundary and global environmental resources affected by transport are not subject to effective multilateral pollution control policies. Thus the risk and likelihood of environmental degradation rises with more international commerce. For example, burning more fossil fuel to ship traded goods could exacerbate global air pollution. However, some of those problems may be partially offset by reduced domestic transportation and air pollution where trade liberalisation shifts supplying patterns to become more proximate to the larger domestic consumer markets. Therefore an assessment of the total environmental effect from more trade requires consideration of changes in national and international shipments. The complete patterns of transportation shifts arising from trade liberalisation and the environmental impacts due to those shifts deserve careful empirical analysis. Because such international environmental management problems apply to all trade flows of which agricultural products are only a small part, the issue will not be addressed in this report, other than to urge its inclusion in a comprehensive trade-environment analysis.

In absence of adequate policy, the introduction of harmful nonindigenous plant, animal and insect species (HNIS) through new trade routes can damage environmental resources. A comprehensive study has documented evidence of significant problems in the U.S. [OTA, 1993]. One case is the invasion of leafy spurge that has extensively degraded western U.S. rangelands. Opening new pathways under trade liberalisation will increase risks of future losses from HNIS. Some international agreements and conventions (for example the SPS agreement of the WTO and the proposed Biosafety Protocol to the Biodiversity Convention) regulate imports, and some OECD countries (for example New Zealand and the Netherlands) have developed policies and institutions to guard against excessive damages from harmful invasions. The U.S. programme effort appears to have focused on human and livestock health rather than the natural environment. That focus is understandable if the environmental resources suffer externality or public good problems because those responsible for importing the destructive species do not pay their full cost.

Most attention, political and scientific, has focused on the environmental repercussions of production changes under trade liberalisation. Expanded trade induces complex shifts in the scale, composition and technologies of agricultural production within OECD and other countries. The likely production effects reflect farmer responses conditioned by agricultural policies and constrained by current technology. So the baseline from which changes are measured reflects any negative or positive environmental effects stemming from current policies. In the longer-term, dynamic adjustments are more complicated as markets and technology evolve in response to new trade opportunities and environmental policy.

Most empirical analyses of agricultural trade liberalisation adopt the short-run, static view because of the uncertain policy, market and technology paths. Moreover, available estimates of global

production changes are largely for whole countries (or regions). Large-scale modeling analyses do not capture the diversity of adjustments necessary to forecast environmental changes. For example, analyses that project the production impacts of URA implementation in the full European Union are of limited use. The heterogeneity of production adjustments and natural resource conditions across EU countries requires more disaggregation to anticipate environmental effects. For instance, a country may move to a more homogeneous agricultural system focusing on a few major crops, thus diminishing biodiversity associated with a broader range of crop and livestock enterprises. Some researchers argue that reliable estimates of environmental effects from production and trade shifts require location-specific natural resource and production detail, as opposed to using aggregate models comprised of large resource units of assumed homogeneous character [Antle and Just; Antle, et al.]. In concept, the use of location-specific detail yields more precision, but such analyses require extensive data that are unavailable for many regions. Using available local data to help inform and check the larger models seems a logical step until more complete data are assembled.

Global studies can identify regions that are likely to experience large adjustments for more intensive study. For example, the effect on world food output of a complete removal of agricultural support policies has been estimated as "...negligible and the relocation of production is minor, e.g., grain and meat production would have been 5 to 6 per cent lower in industrialised countries and 3 to 8 per cent higher in developing countries [Anderson and Strutt, p.5]." These estimates portray the maximum regional shifts from fully liberalised trade not those from the URA.[1] Regions estimated to have larger adjustments offer clues to significant environmental changes (see Figure 1). Japan and Western Europe would experience the largest decreases, from 15 to 50 per cent of their baseline production. In contrast, Africa, Latin America, North America and Australasia comprise the largest increases ranging from 5 to 20 per cent of their baseline production. Because the countries experiencing losses in production currently use more chemicals and practice intensive livestock production compared to the bulk of those increasing production, Anderson and Strutt hypothesise that global environmental pressure from agriculture will fall. However, the net shift in a country's production will likely be composed of heterogeneous responses over its regions. Complicating matters, both increased and decreased production may cause damages depending on the natural resource situation and public preferences. For example, land abandonment in some areas causes environmental loss from degraded landscapes, although in other areas it may regenerate valuable wildlife habitat or other environmental services.

Analyses of national reforms of agricultural programmes, either required or stimulated by URA provisions, might give better clues to the environmental shifts within some countries. Indeed, several studies of the U.S. provide consistent and corroborative results. Generally, the reduction, decoupling or elimination of national production subsidies reduces incentives for fertiliser and pesticide use, pressures to convert environmentally-vulnerable lands to arable production, and other stresses such as irrigation water withdrawals [Ervin, *et al.*; Howitt; Just *et al.*; Miranowski, *et al.*; Ribaudo and Shoemaker; Tobey and Reinert]. However, one study estimated that reductions in U.S. environmental stresses would be uneven and modest [Kuch and Reichelderfer], while another study estimated that bilateral elimination of U.S. and EU agricultural programmes would result in a significant increase in U.S. production and chemical use [Abler and Shortle]. Another analysis of bilateral U.S.-Mexico trade reform indicated modest regional production increases [Burfisher, *et al.*]

Evidence from unilateral policy reform in New Zealand, combined with a downturn in prices, suggests more pronounced effects than from the simulations [Reynolds, *et al.*]. Phosphate fertiliser, pesticide use, and conversion of marginal lands in pastoral agriculture have fallen significantly. Moreover,

1. Such extreme policy reform was not mandated by the URA. In fact, the URA exempted key types of agricultural support from the total support ceiling and reduction schedule, and will phase in constraints over the next decade.

the reduction in sheep numbers and the diversification of pastoral farming has reduced grazing pressure in some hill country areas. Pesticide use in other agricultural sectors, such as horticulture, has risen, land management quality declined on certain farms due to income pressure during the short-term transition period, and some weed and other pest problems rose due, among other factors, to a decline in pest control assistance. The mixed outcomes to New Zealand's policy reform are consistent with the uneven effects predicted by modelling analyses of U.S. policy reform. However, the New Zealand government has judged the overall net effects to be definitely positive. Most importantly perhaps, the government felt that it could not have begun to address the full range of agroenvironmental issues while a complex web of agricultural subsidies was in place. Reform of agricultural support policies was a necessary, though not sufficient, first step to addressing agroenvironmental issues. Sweden has also experienced environmental gains under policy reform from converting land in grain production to grazing.

Conservative simulation estimates are plausible because short-term economic analyses often underestimate the responsiveness of agricultural systems. The simulation analyses for the most part do not account for long-term input substitution and technological innovation that can further reduce environmental stress. This may account for the more optimistic environmental projections of policy reform by studies explicitly projecting technological change [Faeth, *et al*]. One study that factored in normal technological progress (without domestic policy reform) concluded that added environmental stress from projected U.S. export increases under the NAFTA and URA pacts would be negligible [McCarl, *et al*.]. Indeed, the major environmental loading measures, such as erosion and fertiliser use, did not show increases and some even declined over baseline levels.

The removal or decoupling of subsidies lessens production pressures that can exacerbate environmental damages and limit amenity values. Thus, agricultural policy reform, including trade liberalisation enhances the potential for environmental improvement, but does not assure it. The root causes of environmental problems lie in incomplete markets (externalities and public-type goods) in which farmers and ranchers do not face all costs and benefits. Unless the market failures are remedied through public policy or private initiative, some problems will persist, albeit at lower levels, and new problems will arise as production pressure shifts. Batie [1996, p.20] arrives at a similar finding " These studies and conclusion suggest that, in many cases, the enhancement of positive agroenvironmental services (or mitigation of disservices) will require more than agricultural policy reform or trade liberalisation. While policy reform has the potential to improve environmental quality, it is unlikely to achieve desired levels of improvements (i.e., mitigating damages) or enhance the positive agroenvironmental services without other environmental policies." Nevertheless, policy reform corrects government failures that complicate agroenvironmental management.

Estimates of the environmental effects of policy reform are mostly broad inferences based on changes in inputs or loadings rather than shifts in relevant ambient conditions because of inadequate environmental science and data. As noted above, reliable estimates of changes in ambient environmental conditions require knowledge of the spatial and temporal distributions of production pressure on the local natural resource base [Antle and Just]. Those requirements raise the degree of analytical difficulty by an order of magnitude due to the wide diversity of natural resource conditions within and across countries. Moreover, immature science about environmental processes and poor data hinder tight analysis. Thus it is not surprising to find either aggregate studies with broad-brush inferences about environmental loadings, or localised studies of environmental responses without the ability to generalise more broadly [Antle, *et al*.]. Given the analytical and data problems that limit better understanding of agroenvironmental processes, policy should allow flexible management responses to heterogeneous natural resource and production conditions.

Anticipating the ultimate environmental repercussions of agricultural trade liberalisation requires not only detailed production-environment science, but the incorporation of environmental policies. In

general, OECD countries have incentives to treat positive and negative environmental effects from agriculture, but comprehensive national policies do not exist to stimulate technology adoption and innovations that can meet environmental and trade objectives. Actions for transboundary and international environmental issues are growing as well, but are similarly incomplete given the high cost of negotiating and implementing multilateral efforts.

Some of those missing international policies concern environmental management in less developed countries (LDCs) with trade and environmental consequences for OECD nations. LDCs will respond to the agricultural market opportunities opened up by trade liberalisation and in the process affect natural resource conditions through land conversion, tillage, chemical application, irrigation, and other processes [Lee and Roland-Holst]. Despite recent improvements, most developing countries do not have extensive environmental policies to protect against damages from their growth in agricultural production to serve trade expansion [Lutz]. Estimating these risks in LDC settings poses a great analytical challenge. Science about environmental problems related to their natural resources and agriculture is very sparse, limiting analyses of likely risks and benefits. Some environmental changes in developing countries may have global significance, e.g., clearing of rainforests [Giordano].

In summary, the weight of the evidence to date does not suggest that production changes under policy reform, including trade liberalisation will cause broad short-term environmental benefits or damage. Some improvements can be expected from this process, but "pockets of stress" from concentrated production and land abandonment, HNIS invasions, and problems in non-OECD countries are likely to occur. Larger risks lie in the long term when trade liberalisation will be further implemented and a rapidly growing world population will push up food demand and prices. Creating environmental policies for these uncertain problems with minimal trade effect presents a major challenge.

### *2. Broadening environmental policy can threaten trade expansion*

Rising incomes in OECD countries and a growing appreciation of the linkages of agricultural production with environmental health underpin public desires for improved environmental quality. Surveys in the U.S., for example, invariably reveal two-thirds of the respondents do not wish to relax efforts by agriculture in cleaning up water quality, air quality and other environmental ills [Roper-Starch]. Indeed, a clear majority of the respondents expect and favour more environmental regulation of agriculture [USDA,NRCS]. Those strong public sentiments stir concern in agriculture that the potential benefits of trade liberalisation may suffer due to broader environmental initiatives.

Until recently, that fear has been moot. Agroenvironmental programmes for agriculture have predominantly used voluntary, subsidy approaches to offset cost increases for producers [OECD, 1993; OTA, 1995a]. Some of these subsidy programmes limit production and trade, without any benefit-cost rules or market disciplines justifying such limitation. A case explored below is the use of land set aside when other measures can keep land in production and achieve the environmental objectives.

Some regulations also constrain production practices, such as rules for pesticide use and conversion of wetlands. The regulation of pesticides via registration/admissions policy attempts to balance the potential human and environmental health risks against the benefit of the compounds in production. However, some perceive a growing risk from a general expansion of regulation implied by recent policy developments and supported by the robust public sentiment expressed in polls. Given the rudimentary science on many agroenvironmental problems, regulation often must rely on subjective estimates of certain effects and therefore may cause excessive restriction and cost. Traditional regulations of the command-and-control variety inevitably constrain producer flexibility. To producers, their expanded use in a diverse and diffuse agriculture may in some cases result in large inefficiencies and diminished

agricultural production growth and trade competitiveness. Reaching that conclusion, however, depends upon the environmental policy actions taken by competing exporters because trade theory rests on the notion of comparative advantage not absolute advantage. A new generation of environmental regulatory programmes, such as tradable permits, offer the potential to reduce cost and trade impacts. But they have been sparingly applied, mostly for air pollution control, and not in agriculture. The nonpoint character of much agricultural pollution complicates the application of such trading schemes [Malik, *et al*.].

While growth in environmental regulations could threaten trade competitiveness, the more serious worry may be the use of environmental rules as NTBs. Recent evidence will show that NTBs related to natural environment issues in agriculture are still relatively rare. However, if the definition of environment is expanded to human health and food safety questions, then the potential for trade restriction becomes much greater. As the URA provisions phase out other nontariff barriers, many exporters expect a plethora of environmental NTBs to replace them. Prime examples may be actions taken to limit trade in bioengineered food and fibre products and in imports risking introductions of HNIS. Poor science and lack of international institutions to guide such decisions, such as the Codex Alimentarius for food safety issues, open the possibility of wider constraints on trade.

Strong public values for environmental health extend beyond OECD countries to transboundary and global issues. Since 1970, a number of international environmental agreements (IEAs) have been signed, although the efficacy of these pacts varies widely. The Montreal Protocol on Substances that Deplete the Ozone Layer, one of the most visible agreements, has exerted significant effect [Barrett, 1994]. In contrast, the recently signed agreement to reduce greenhouse gas emissions that risk global climate change and the framework convention on conserving biodiversity are still in their infancy with uncertain timetables and efficacy. While IEAs will contribute to environmental protection, they should be applied in ways to avoid any unnecessary effect on agricultural trade expansion. The threats are troublesome because the science of global environmental processes and institutions that govern the IEAs are both immature.

To summarise, the threats to trade expansion from present agroenvironmental programmes appear minimal, but growth in land set-aside could limit it. Proposed actions to broaden and strengthen environmental regulation of agriculture without proper cost-benefit analysis add concern. Perhaps the largest worry concerns proper application of environmental trade measures for which inadequate rules exist.

## IV. Will economic growth from liberalised trade stimulate environmental policy?

Environmental policy attempts to reduce environmental degradation and enhance amenities through product, technology, scale, structural and regulatory effects (see Annex 1). A general conceptual argument that explains the links in the trade-income-environmental policy process has been advanced. Standard economic theory concludes that liberalised agricultural trade increases social welfare. By specialising in the production of food and fibre products for which it has comparative advantage, each country's allocative market efficiency can be improved, thus permitting higher national and global economic growth. The returns from that higher level of growth enhance individual incomes, which in turn raise national welfare.

Some critical assumptions lie behind this powerful logic when it is applied to the trade-economic growth-environmental policy linkages [Runge, 1995]. By improving allocative market efficiency through liberalised trade, the country enjoys higher economic growth and incomes, but the growth also generates negative pollution effects from the increased scale of economic activity. Increased incomes raise the social demand for environmental quality which translates into policies that shift product composition and

techniques of production to meet public environmental objectives via less pollution and more positive environmental services.[2]

This simple linear conception of action then reaction presumes policies are not in place, ex ante, to avoid economically significant pollution (those cases for which the benefits of reduction exceed control costs) as growth proceeds. But if the conclusion that trade improves social allocative efficiency (and welfare) is to hold, environmental shadow prices must be included in the calculus through the entire chain of events from the start. This requirement reminds us of the basic conclusion that the welfare superiority of liberalised trade depends upon mechanisms to internalise the external environmental costs and benefits not just for static efficiency [Anderson,1992], but for dynamic efficiency as well.

### *1. Evidence shows mixed environmental effects of income growth*

The total environmental effect depends upon the country, the size of the trade stimulus, the production response, the policy response and the specific problem in question. But, the key factor in determining the ultimate environmental effect of trade expansion is the responsiveness of remedial policies to increased income. Economic theory states that as incomes increase, individuals are willing to pay more for all normal goods, including environmental services such as cleaner air and water. Indeed, some authors have argued that individuals will increase their demand for environmental quality by a greater percentage than the per cent rise in income [e.g., Cochrane and Runge]. However, there has been a lack of systematic evidence to support the assumption of environmental quality as a "superior" good. In a recent analysis of evidence from European countries, environmental quality was found to be a normal economic good whose demand rises less than proportionately with income, i.e., an income elasticity of about 0.4 [Kristom, 1994]. Separate studies of environmental pollution cases corroborate this general finding [e.g., Carson, *et al*.].

But what then can explain the observed higher effort at environmental protection in higher GDP countries? Two combined forces may be at work. In addition to the stronger demand for environmental quality from increased incomes, the scarcity value of rural environmental services may be rising as development reduces their availability. Increasing numbers of urban residents seeking recreational experiences and housing in rural areas illustrate the latter effect. This interpretation is consistent with the theory that environmental degradation at first rises as a country's income grows before reversing itself at higher levels. This relationship is appropriately termed the "hump" effect.

Empirical evidence on this nonlinear income-environmental quality relationship has accumulated. An often-cited study by Grossman and Krueger supports the "hump" effect. They hypothesise that trade induces shifts in scale, product composition (from maufacturing to services) and production technology that will at first degrade environmental quality but then eventually improve it from induced environmental policy innovation. Only by empirically testing the notion can the shape of the relationship be discovered. By comparing data on sulfur dioxide and smoke emissions with average incomes in 42 countries, the authors found that concentrations of these pollutants increased in major cities of countries where the per-capita income was below $5000, but declined after per-capita incomes exceeded that figure (but then rise again above $15,000). These findings demonstrate the inverted U-shaped relationship between environmental degradation and income (up to $15,000).

Whether the findings for air emissions hold for other environmental quality problems, including global environmental resources, is a key question. A 1992 study by Lucas and others of 80 countries shows that toxic pollution invariably increases across the range of existing per-capita income levels,

2. Note in this simple conception of the process adapted from Runge [1995], structural effects are not broken out separately but can be interpreted to fall within the product and technology categories.

although the rate falls as the income level rises. Lucas [1996] extended the analysis to a broader set of environmental variables - industrial carbon dioxide emissions, manufacturing toxic and pollutant emissions, land and water use including wilderness, deforestation, freshwater withdrawals, threats to species from marine catch, pesticide use and other forces, and emissions and wastes including chloroflourocarbon and methane, municipal waste and nuclear power. The expanded analysis also uses income measures that permit the inclusion of more countries in different development stages, tests for the influence of a country's outward orientation to trade (exports as a per cent of gross domestic product), and controls for a variety of natural resource characteristics that could easily influence observed environmental values. Time series data allowed an examination of the influence of the growth rate of income for carbon dioxide and manufacturing toxic pollution waste emissions, but not for the other categories.

Overall, the findings were mixed as would be expected in such a large study covering so many different countries and environmental dimensions. Nonetheless, two major conclusions emerged. A remarkably consistent finding is that income growth in low-income countries accelerates environmental harm, then the effect tapers off in middle income levels, and finally reverses at higher income ranges. Although there are exceptions, the general thrust supports the inverted U relationship between environmental quality and per capita income level. But the relationship is not uniform for all environmental dimensions. The level at which more income turns from harm to improvement ranges from about $2000 (US$1987) for wilderness and deforestation to $13,750 for pesticide use, up to $25,000 for carbon dioxide emissions. Second, most estimates indicate less environmental harm as export orientation increases, especially for smaller countries. Again, there are important exceptions to this general finding, such as the significant role roundwood trade has on the loss of wilderness and species within.

### *2. Mixed and Small Effects on Agriculture*

Questions about wilderness, deforestation, pesticide use and threaten species pertain most directly to agriculture. In general, the findings indicate agriculture plays mixed roles in nationwide environmental quality, but not as large as one might think when other factors are controlled (note that the analysis does not cover some positive environmental services provided by agriculture):

- Total arable land area and the number of livestock do not exhibit significant effects on wilderness area.

- Agriculture and cattle in particular play a significant role in deforestation of the tropics; agriculture in general is not found to exert significant pressure on water use on average, although the important role of irrigation was not examined due to missing data; inclusion of irrigation withdrawals would likely show significant pressure in many areas.

- Evidence that agricultural activities increase pesticide use on average is weak though a slight positive association with the amount of arable area exists.

- More amphibians, reptiles and mammals are threatened where arable farming is more extensive, and more birds and mammals where the numbers of cattle are greater.

Despite the improvements made by the latest Lucas study, this type of macroeconomic analysis remains largely a test of the degree of association between aggregate income and countrywide environmental variables. At their strongest, they may be viewed as reduced form relationships. However, the causal processes and the demand and supply equations for environmental quality remain unspecified, unmeasured and untested. Fundamental questions about what structural forces produce what environmental results in what settings remain unanswered. Moreover, the use of aggregate environmental

quality and quantity measures to capture overall national environmental health are dangerous exercises. Nonetheless, such macroeconomic analyses lend insight into the major patterns across countries and suggest avenues of further in-depth inquiry.

Evidence on the income-environmental quality relationship shows that growth in aggregate income levels induced by trade liberalisation is associated with increased protection of many environmental quality components after initial degradation. The finding applies to agricultural sources of pollution. However, the scope and strength of overall environmental effects appear mixed and small. Just how much environmental improvement can we expect from trade liberalisation? Much depends on the size of the income boost from trade expansion. Consider the U.S. as an example case. Given that expanded U.S. trade will not change either production patterns or income dramatically (estimated at less than 0.20 per cent of GDP) over the next five years, the short-term effect is likely to be small [Schott]. In the long run, income growth from general development including expanded trade will push national environmental performance higher, but only gradually. The nature of that improvement depends on the incentives for technology development and behavioural change encouraged by environmental policy.

A distinguished group of economists and ecologists caution that income growth may not induce sufficient improvement to ensure environmental sustainability [Arrow, *et al.*]. Their uncertain verdict stems from the unevenness of coverage across quality components (especially for transboundary resources), the unknown extent of remediation of environmental damage after growth moves through the harm phase, the irreversibility of certain environmental damages, and the efficacy of environmental policy responses that alter product composition and production technologies. They conclude that trade liberalisation and other economic growth policies are not substitutes for environmental policy. Ayres [1995] takes a stronger view and rejects the notion that economic growth will ensure sustainable development. His primary argument is that the "hump" effect does not apply to the class of environmental problems that determine the biosphere's long-run carrying capacity and ecosystem resilience. Key shortcomings, in his opinion, stem from incomplete environmental policies at the national and international levels and distorted trade regimes that flow from those policy failures.

The ultimate policy response also likely depends upon the degree of publicness of the environmental problem and its international character. For current issues that have easily perceived effects on domestic parties, such as local land and water use, the rise in income may precipitate early and effective policy responses. However, for issues that generate diverse environmental benefits some of which extend beyond country borders, the policy response may be at much higher incomes. Whether the endogenous policy response extends to global environmental resources, such as climate and ocean conditions, is unclear because of the difficulty of using national actions to cooperatively manage those resources. That hypothesis is consistent with the Lucas finding that carbon dioxide emissions do not turn down over any country's average per capita income level (up to 24, 568 in 1987 U.S$). The influence of trade liberalisation and economic growth on key transboundary and global resources likely remains negative.

## V. Do national agroenvironmental management programmes inhibit trade?

OECD countries use a wide array of approaches to reduce environmental pollution and to provide public goods from agriculture [OECD, 1993b]. The dominant trends are toward broader coverage of environmental issues, and toward stricter controls to make progress on persistent problems such as nonpoint water pollution [OTA, 1995a]. As an illustration, spending on U.S. agroenvironmental programmes during 1985-94 rose to approximately $40 billion [USDA,ERS, 1994]. Given the robust public values for environmental improvement, the growth in programmes could well continue. Witness the expansion of 1996 U.S. farm bill conservation funding to roughly $2.5 billion per year.

A natural question is whether some or all of the environmental programmes conflict with agricultural trade liberalisation. Two areas deserve attention - total present compliance cost, and the nature of future programmes. Direct evidence on their trade competitiveness effects is sparse. However, inferences can be made using findings for other industries and knowledge of agroenvironmental programmes in OECD countries.

### *1. Little evidence that environmental regulation affects trade competitiveness*

Studies have examined the trade effects of environmental regulations chiefly by analysing the relationships between trade and the pollution abatement costs (PAC) for industrial sectors (Annex 2). PAC comprise a small share of an industry's costs (on average less than 2.0 per cent), but vary considerably over sectors. Differences in PAC between countries have declined over time. Comprehensive reviews conclude that compliance costs have caused small and insignificant output reductions on average, and show little if any evidence of any significant impact on the patterns of trade [Dean, 1992; UNCTAD, 1995]. A few studies have found significant trade effects, but their findings have not been widely corroborated [e.g., Kalt]. Aside from low PAC, the lack of significant effects may be due to management and technology innovations that lessen regulatory costs, and from similar environmental programmes across competing exporters.

If production costs rise sufficiently from environmental regulations, some firms may also migrate to countries with lower compliance requirements. Their movement may reflect an intentional economic loss because the industry creates such large environmental damages. If the countries charge for significant environmental costs and compensate for benefits left out of market prices, then such moves can leave both countries better off. But concluding that the shifts improve global economic welfare depends on whether policies have been implemented at home and abroad to count significant environmental costs and benefits. It also raises the question of international environmental ethics, and whether shunting environmentally-damaging production abroad is morally responsible, especially as decisions on industrial development are not made democratically in some developing countries.

The evidence for the industrial migration phenomenon is unsurprisingly similar to the evidence regarding production costs. Firms base their overseas location decisions on a variety of factors, including labour productivity, infrastructure, transportation costs, and other cost considerations. If PAC are relatively small, then the incentive to reduce these costs by relocating is small as well. Most studies have found little evidence that PAC have affected industrial location decisions [Leonard, 1988; Dean, 1992; Low and Yeats, 1992].

In summary, research indicates that present environmental regulations have little effect on trade patterns or on industrial migration, but two important qualifications to the conclusions should be kept in mind. First, some specific industries may spend very different amounts on pollution control and face considerably different competitiveness pictures. Analyses of aggregate trade flows may miss specific effects on high PAC sectors that become apparent in disaggregated investigations. Case analyses show that a few sectors with high PAC have been disadvantaged in trade, such as Los Angeles furniture industry [OTA, 1994]. High-cost sectors may suffer from unfavourable pairwise differences with their competing exporters. Even small amounts may be important in increasingly competitive international markets under trade liberalisation. Second, the studies are backward looking by necessity, and subsectors that anticipate much strengthened environmental requirements, such as agriculture, require careful monitoring.

*Implications for Agriculture*

Diminished trade competitiveness from high agroenvironmental cost has not surfaced as a major issue until recently. Environmental programmes for farming and ranching have traditionally relied on voluntary-subsidy approaches [OECD, 1993b]. Application of the polluter-pays-principle (PPP) has been rare, reserved mostly for regulation of pesticides and certain forms of water pollution [Tobey and Smets]. OECD policy supports application of the PPP over subsidies because full cost internalisation stimulates incentives to correct significant damages and encourages innovation in pollution treatment. The extensive use of subsidies in OECD countries presumably reflects that farmers and ranchers have retained broad rights in the use of natural resources and require compensation for any diminution of those rights. Subsidies therefore have been necessary to reduce significant negative environmental effects or enhance positive amenities coming from farm practice. The sanctioning of agroenvironmental subsidies in the URA likely reflected these political realities. In principle, if the subsidies are limited to the minimum compensation necessary to entice the changes, and are structured to encourage innovations that dynamically improve the cost-effectiveness of achieving environmental improvements, i.e., incentive-compatible, they do not necessarily distort trade. However, in practice, if the subsidy exceeds the necessary compensation and does not encourage such cost savings, they can attract capital to the industry and enlarge supplies, thereby aggravating negative environmental problems. Some U.S. agroenvironmental subsidies have not met the minimum compensation and incentive-compatibility requirements [OTA, 1995a]. Nonetheless, agroenvironmental subsidies in OECD countries apparently had not reached trade-distorting levels by the early 1990s [Tobey and Smets].

The net social costs of agroenvironmental programmes in OECD countries, including subsidies, direct regulatory measures, and indirect regulations such as food additive restrictions, have not been tallied. Some country studies have attempted estimates, but their data are scant [Gardner, 1993]. Past conservation and environmental subsidy programmes have transferred resources into agriculture in many countries [Paden; Sutton]. Examples include cost sharing for terrace construction and wetlands drainage, land retirement payments, and below-market financing costs for irrigation development. Those efforts have likely boosted production and trade, especially when coupled with production and export subsidies. As just explained, the agroenvironmental subsidies have distorted trade flows to the extent they exceeded the minimum necessary compensation and thus distorted production cost and supply.

Whether PAC have distorted agricultural trade has not been tested directly because of missing data. Tobey [1991] estimated the potential for different crops to generate pollution and correlated the estimates with the revealed comparative performance of crops in the world market. He found that the crops that perform well in world markets also have the largest pollution potential. Therefore, stringent programmes to control that pollution could affect their trade performance. However, he concluded that the magnitude of trade competitiveness losses is likely to be quite modest for three reasons. First, most competing exporters have introduced similar agroenvironmental programmes, which implies that the relative trade competitiveness effects have not likely changed significatively. Second, LDCs do not hold large market shares in most of the commodities. Finally, competitiveness effects of agroenvironmental programmes are likely to be swamped by larger forces such as labour costs and exchange rate fluctuations.

An extension of that analysis assumed that each crop's relative pollution potential was directly correlated with the proportion that PAC comprises of total production costs, and empirically tested for trade distortions [Diakosavvas, 1994]. In contrast to Tobey's findings, the estimates did find significant trade distortions due to the assumed PAC measure. However, given that most OECD countries used voluntary, subsidy approaches for agricultural pollution control during the analysis period, the assumed PAC relationship is suspect. Therefore the findings of significant trade effects must be considered questionable.

Evidence that past agroenvironmental policy has not affected trade cannot be treated as necessarily indicative of the future. The mix of programmes has begun to change with conservation (compliance) requirements, and more mandatory measures and charges [OTA, 1995a]. Regulations governing fertiliser applications, runoff from confined animal feeding operations, pesticide use, and species/biodiversity habitat are becoming more expansive. The rights to use the natural resources in agriculture are more and more regulated, thus diminishing the rationale for subsidies. What were once considered benefits to farming, such as agrichemical waste disposal into surface and ground waters, are increasingly becoming pollution costs. These dynamic shifts in the rights to use environmental resources alter the direction of causation of pollution and the cost responsibilities under the PPP (Bromley). New Zealand reports that the PPP is generally applied to their agroenvironmental programmes with the exception of soil conservation [Sinner, *et al.*]. Moreover, conservation subsidies may rise as production subsidies decline. The prospect of broader agroenvironmental controls has generated worry that the cumulative costs could significantly reduce a country's competitiveness versus competing countries that impose less regulation.

Whether agriculture will become a high PAC or a high environmental subsidy sector - that is, whether farmers' extensive use of land and water means that their costs will rise appreciably or these resources will be diverted from production - is not yet clear. Some commentators speculate that present trends in agroenvironmental programmes could be a major factor in distorting agricultural trade by raising production costs and providing justification for restrictive policies abroad [Gardner, 1996]. That assessment is not shared by others [Whalley], but they admit that major future global initiatives, such as a carbon tax, could exert profound trade effects.

The absolute rise in a country's agroenvironmental compliance costs is not sufficient to judge competitiveness effects. That depends upon comparable actions taken by competing exporters worldwide. Differences among OECD countries PAC levels has been diminishing and many are increasing the breadth of agroenvironmental programmes. What seems clear from the evidence is that differences in agroenvironmental costs currently exert a negligible overall distorting effect on trade between OECD countries. Also, the existing production patterns of non-OECD countries do not suggest that uneven agroenvironmental requirements greatly affects trade by OECD countries although more study is needed.

### *2. The Uncertain Effects of Future Agroenvironmental Programmes*

Future agroenvironmental programmes may impose significant effects on trade. Land set-aside programmes that fully compensate producers for diverting land from production hold that potential. The banning of methyl bromide used to fumigate soils and preserve perishable exports of fruit, with no apparent substitute, is another example.

#### *Land Set-Aside*

Cropland set-aside has been a fixture in U.S. commodity and conservation programmes for over half a century. EU agricultural policy has also introduced set asides. Total U.S. diversions exceeded 20 million hectares in approximately one-third of the years that land has been idled. It climbed to a peak of just over 30 million hectares in the late 1980s [USDA,ERS,1994]. Enrolment in the Conservation Reserve Program (CRP) alone reached 14.75 million hectares. The CRP was authorised in 1985 to reduce soil erosion and to control supply, but has been renewed in 1996 with a principal environmental objective.

What effect has the CRP had on production and trade? That question has been easier to ask than to answer because of the confounding effects of commodity programmes. Those commodity programmes

have used other set-aside for supply control (the Acreage Reduction Program, ARP). USDA economists first estimated significant reductions in production (from 6 to 20 per cent for different crops ) for a projected 45 million acre CRP [Young and Osborn]. But their analysis assumed relatively high ARP levels (to keep large stock levels from climbing further), which exacerbated estimated production declines and price responses from the assumed CRP withdrawals.

After the drought of 1988, ARP levels were dropped reflecting the substitute nature of the two set aside programmes in practice. Subsequent analysis reflected lower stock levels and readjusted ARP set asides. The basic conclusion did not change - the CRP was projected to generate net economic benefits, mostly from environmental improvements as higher consumer food prices cancelled out increased farm profits [Osborn]. However, net government cost was estimated to be positive because the price increases were insufficient to lower deficiency payments enough to outweigh CRP expenses. However, trade losses were not counted and therefore, the analysis did not fully capture trade effects, in particular the foreign supply response.

A recent analysis focused explicitly on the trade consequences of the CRP [Leetmaa and Smith]. The study simulated a reduction of the CRP from 14.75 to 6 million hectares during the 1992/93 crop year. Estimates indicated significant trade constrictions by the CRP. U.S. export revenues from barley, corn, sorghum, and wheat were estimated to rise $444 million or 4 per cent had the CRP been smaller. The U.S. share of the wheat market was estimated to rise 2 per cent, mostly at the expense of Canadian producers. ARP levels were assumed constant. The authors note in conclusion that the trade gains would need to be weighed against environmental losses from CRP lands returning to production.

What has become increasingly clear about the CRP is that the effect on production depends critically on the total set aside. As world stock levels have dwindled recently, ARP requirements have been virtually eliminated to release idled production capacity to fill world demands. Presumably, had the CRP not been in place, the ARP levels would have been maintained at higher levels to withhold sufficient U.S. production capacity to meet farm price and income support objectives. Under this interpretation, the production effect of the CRP is negligible because it operates as just another supply control instrument to dampen the incentives to overproduce. That interpretation is likely too simplistic, because the CRP adds another level of complexity, that of inflexibility because 10 year contracts cannot be as easily altered as annual ARP levels to respond to crop shortfalls.

A broader study of the production and trade effects of large-scale land idling in U.S. agriculture addressed the combined effects of both set-aside programmes [Abel, Daft, and Earley]. The authors simulated a reduction in the CRP from 14.75 to just under 7 million hectares and a complete elimination of other land idling under ARP. Unlike the Leetmaa-Smith static analysis, the study projected into 2002/03 and accounted for world agricultural market growth and yield increases from technology. The CRP lands that returned to production fell in land capability classes I-III, which implies the land is suitable for cropping if good soil conservation practices are used. The study projected gains in U.S. consumer and producer welfare from price moderation and increased volumes of production and exports to meet growing world demands. Also, growth in U.S. exports would not pose a major threat to competing exporters because the increased trade would be mostly from sharing in global market expansion.

The preceding analysis of the CRP may be prescient. Under the new farm bill, supply control measures ceased and farmers receive a set of declining payments over 7 years that are independent of current production of a specific crop, yields, or price. That is, decoupling has been approved. The CRP is authorised to reach its present level, although fewer and different lands could be enrolled. Thus, supply-enhancing measures are no longer available to offset the CRP, and production losses will restrict exports. Under the new world trade liberalisation, a host of other suppliers can fill in for that production limitation. U.S. producers would experience trade losses and consumers would pay higher prices to be

counted against environmental benefits. A positive national benefit-cost result is not ruled out, but the tradeoff equation has changed. More emphasis is placed on enrolling only those lands for which expected environmental benefits exceed costs. The USDA is using an improved environmental benefits index and rules to avoid paying rents in excess of market rates to help ensure net benefits.

The European Union's Common Agricultural Policy (CAP) contains an annual set-aside programme that serve goals of supply control, and a long-term programme for environmental protection. Although CAP reform has partially decoupled agricultural payments, supply-enhancing measures are still implemented and annual set-aside continues to play a role of supply control with few environmental benefits. For the long-term programme, the benefit-cost calculus of CAP set-aside becomes the same as for the U.S. Do the environmental benefits of land idling outwiegh the losses from higher food prices and lost trade profits? If the same environmental benefits can be attained with a lower cost measure that does not remove the land from production, then set-aside is not only trade distorting but decreases domestic welfare and drains budget resources.

*Controls on Chemical Use*

Virtually all OECD countries regulate the introduction or use of agrichemicals [OECD, 1993b]. Nutrient applications from manure or other fertilisers need to be controlled essentially where surface or groundwater resources are vulnerable. Pesticide risks are controlled by registering only those compounds deemed to be without excessive risk to human and environmental health and through general reduction efforts (for example, Sweden and the Netherlands have achieved reductions of 65 and 35 per cent over the last decade). Pressure for such reductions is becoming more commonplace. Understandable concern emerges about the effects on trade competitiveness of such controls.

The EU Nitrate Directive may be the most studied of the chemical controls. In response to drinking water quality concerns, several countries are restricting organic or inorganic nitrogen applications or requiring other management measures. The Nitrate Directive sets a benchmark limit on nitrate levels, but does not require uniform methods of implementation across EU countries. Some may choose subsidies to persuade farmers to lower fertiliser use in vulnerable areas, others may resort to regulation, while the remainder may use some combination of the two. Some measures implemented to date feature command-and-control regulations, presumably to assure improvements for critical water quality use [Blom]. Economic incentives or disincentives appear to have played little or no role in implementing those regulations. The major effects of the Nitrate Directive appear to be confined to the livestock sector. Blom concludes that intensive livestock will shift from current regions of concentrated production to regions of arable farming. Production should not decline considerably in his view, but given the EU's importance in the world market, there might be a relatively larger trade effect. Blom also stresses the likelihood that technology improvements could ameliorate a good deal of the effects over time.

Leuck and Haley simulate the livestock production and trade effects using a formal modelling analysis. They consider the opposing effects of CAP reform, which stimulate livestock production through lower feed cost, and nitrate limitations which decrease production. The authors estimate that the Directive coupled with CAP reform implies possible reductions from 1 per cent for sheep to 12 per cent for pigs. The U.S. gains from the EU's nitrate controls by filling the trade void left by the EU. The authors do not speculate or analyse how alternative nitrate control measures could mediate the trade losses.

Another agrichemical control issue with trade implications is the proposed reduction and elimination of methyl bromide as a pesticide for production and processing. Under provisions of the Montreal Protocol to reduce ozone depleting substances, some signatory countries have scheduled phase outs of the chemical. Although substitutes for methyl bromide are being researched and developed, e.g.,

heat treatments, use of carbon dioxide and diatomaceous earth, at this point good economical substitutes for the pesticide do not widely exist. Understandably, agricultural producers in the countries where the chemical is scheduled for elimination fear lost trade opportunities. For example, U.S. fruit and vegetable growers risk losing lucrative export markets of $1.1 billion because import regulations require all incoming products to be treated with methyl bromide to avoid unwanted pests [Forsythe and Evangelou; Yarkin, *et al*.]. Producers in the southeastern and western states face estimated losses of $1 billion per year if methyl bromide is banned as a soil fumigant unless new economical substitutes emerge [Ferguson and Padula]. Despite these losses, the environmental benefits from the phase out have been estimated to far exceed the costs [U.S. EPA].

In summary, this chapter has established two major conclusions. First, current agroenvironmental programmes in OECD countries likely exert negligible trade effects. Second, growth in environmental programmes for agriculture driven by strong public preferences for environmental quality will enlarge any trade effects. Land set aside programmes hold a large potential to affect trade when environmental objectives can be achieved while retaining land in profitable production. Increased reliance on regulations restricting agrochemical pollution may also affect trade in some cases. But, the degree of trade distortion depends critically on the design of future agroenvironmental programmes.

## VI. Environmental trade measures: can the environmental benefits and the risks to trade be balanced?

Trade and environmental advocates debate the merits and demerits of using trade restrictions for environmental purposes. These environmental trade measures (ETMs) have existed for decades but an expanding environmental agenda and new trade liberalisation pacts have invigorated discussions of their desirability [Charnovitz]. From the trade perspective, ETMs can address environmental risks linked to trade but only under GATT rules requiring adequate science, least trade distorting measures, and other provisions. Otherwise they run the risk of encouraging disguised nontariff barriers [Runge, 1990]. From the environmental perspective, ETMs are one of the few levers to protect against trade-induced degradation, especially to transboundary and global environmental resources. However, their use is tightly circumscribed by GATT rules.

GATT provisions permit two categories of general exceptions that can support trade-related actions for environmental purposes. Article XX(b) allows measures that are "necessary to protect human, animal or plant life and health." Article XX(g) grants exceptions for measures "relating to the conservation of exhaustible natural resources." Any measures implemented under the exceptions must be applied uniformly to the product in question, whether imported or domestically produced, to avoid discrimination between countries. Actions taken under articles XX(b) and (g) generally apply to a product's characteristics (product standards), but may also apply to the product-related process and production methods ( hereafter product-related process standards). An example of a product standard is the maximum amount of pesticide residue on imported fruits. A product-related process standard may relate to the production methods, such as dairy farm sanitary conditions [Charnovitz].

These GATT rules protect importing countries against food and environmental risks caused by imported goods, but also ensure that exporters do not suffer unfair product requirements in foreign markets. Actions related to the production process generally concern food safety, such as inspections of food processing and meat slaughter. The intent is to use product-related process requirements in lieu of costly border inspections to screen imports threatening excessive risk. Technically, the regulation is on the product but it relates to the process of production. The same rules must apply to domestic and foreign production processes.

Whatever their legitimacy, some uncertainty surround the use of ETMs. There has been some discussion but no agreement on the conditions justifying a legitimate trade action for environmental purposes. Given the rising trajectories of trade and environmental management, the number of cases involving the application of trade-related measures for environmental purposes will likely grow. Implementation of the URA should clear up some of the uncertainty, because it explicitly recognises general links between trade and the environment. The new World Trade Organization (WTO), created to implement the URA, is charged to pursue the objective of sustainable development. Moreover, it has a full Committee on Trade and the Environment (CTE) to deliberate and clarify issues. The CTE is in the early stages of operation.

The proper use of sanitary and phyto-sanitary (SPS) measures to protect environmental health from imports and from unfair trade restriction is a central ETM issue for agriculture. The URA contains new SPS and Technical Barriers to Trade[3] (TBT) agreements to clarify legitimate trade and environmental objectives and minimize disguised barriers to trade. ETMs are subject to new the SPS rules as explained below.

### *1. New sanitary and phytosanitary rules guard against trade barriers and enable national environmental standards*

Two major objectives of the SPS agreement were to prevent the use of false criteria for limiting food exports, and to ensure the maintenance of high food safety standards. SPS rules define the conditions under which a country can impose trade measures to protect human, animal, or plant life or health from risks arising from the spread of pests and disease, and from additives or contaminants found in human food, beverages or feedstuffs. Possible actions include quarantine procedures, food processes and production methods, meat slaughter and inspection rules, and procedures for the approval of food additives or for the establishment of pesticide residue tolerances, and others. The new SPS rules require measures based on scientific principles, the use of international standards as minimums where they exist (thus achieving partial harmonisation), risk assessments, preservation of governments' rights to set their appropriate level of risk protection and standards (to avoid downward harmonisation), least trade restrictive measures, avoidance of disguised restrictions on trade, and the opportunity for governments to demonstrate equivalency of protection from different measures, e.g., chemical versus nonchemical treatments.

Natural environment purposes were not stressed in the SPS agreement. Nonetheless, the new code enables the 123 signatory countries to use product and product-related process standards for those objectives as well. As noted above, broader use of ETMs under the SPS code raises the possibility of countries erecting nontariff barriers to replace those lost in the URA. A frequently cited example is restrictions on importing biotechnologies. Some countries may restrict the importation of bioengineered products alleging that they may destroy indigenous plant or animal populations and thereby degrade the natural environment.

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3. The TBT rules define appropriate uses of product standards, technical regulations and conformity assessment procedures. Under those rules, measures must not discriminate against imports, must be no more trade restrictive than necessary, and be established in a transparent process. The use of international standards as domestic standards is encouraged and governments rights to adopt more stringent standards are protected. The TBT agreement defines appropriate uses of product standards but does not cover production process requirements. This omission is of particular relevance to environmental management, because most environmental problems emanate from the production process, not from the products.

In many environmental cases, there is immature science to either defend or refute the use of ETMs. GATT rules impose the burden of proof on the country using ETMs, thus forcing the country to defend its action as an Article XX exception [Esty]. The crucial test for environmental issues comes in whether GATT panels will approve product and process standards for environmental purposes and under what conditions. Most cases relating to environmental matters brought before past GATT panels were either ruled as not applicable to the exceptions code or not a basis for an exception [OTA, 1992]. A review of key cases does not reveal a clear and consistent set of principles for countries to plan the use of ETMs [Esty]. Thus there is little documentation on the GATT processes addressing trade-related environmental risks. The panels that rule on such disputes have not included environmental scientists in the past. Perhaps diverse findings by the panels should not be surprising given diversity of the panels and the specifics of each case. Clarification of the scope of Article XX exceptions related to the environment by CTE deliberations will aid national decision-making and multilateral actions.

### *2. Relevance to agricultural issues*

Answers to two basic questions help assess the relevance of ETMs to agriculture. First, are serious ETM conflicts impairing agricultural trade liberalisation? Second, do ETMs effectively protect against environmental damages from agricultural trade?

*How commonly do ETMs restrict agricultural trade?*

Although ETMs are often alleged by the agricultural trading community to constitute NTBs, there is a surprising lack of empirical science documenting their nature, number and effects. The prevalence of ETMs often comes to the public's attention through well-publicised cases brought to the GATT. However, judging the extent and degree of potential ETM restrictions affecting agriculture is impossible through GATT panel rulings because of insufficient numbers of cases. Some assessments have been conducted of late to begin to construct an aggregate picture but only for a few countries.

One survey analysed the impact of environmental standards on the exports of southern U.S. commodities [Marchant and Ballenger]. The authors interviewed experts for the region's major export crops to assess the extent to which domestic or foreign product and process standards affected trade. In general, their findings did not reveal extensive and significant effects on trade from either current domestic or foreign environmental actions. The pending U.S. action to phase out methyl bromide under the Montreal Protocol to reduce ozone-depleting substances was the exception.

The first comprehensive assessment of technical barriers to U.S. agricultural exports is also underway [Roberts and Siddiqui]. Technical barriers in this analysis encompass all product or product-related process standards that impede U.S. exports regardless of their legality vis-a-vis GATT rules. Therefore they could include transparent violations of existing SPS and TBT codes, legitimate applications of the codes as judged by GATT rules, or applications of product and process standards that have questionable legitimacy. The authors report that an extensive survey of U.S. Department of Agriculture field staff identified approximately 200 potential technical barriers that constrain nearly $2.35 billion in U.S. exports. South Korea, Japan, China, the European Union and Mexico rank as the top five (by value) in using the trade barriers. East Asian countries led any other region in barriers, and the exports of processed and horticultural products suffered most. Most barriers are SPS applications, although a few TBT actions accounted for large dollar values. The largest categories on a dollar basis were for plant health and food safety, and for processed and horticulture products. In the authors' judgement, only a very small proportion of this extensive list of technical barriers were exclusively directed to natural environment

issues. However, the plant health category likely includes actions taken for joint commercial and natural environment purposes.

Another study examined the effect of a developed country environmental standard on the potential for exports by developing countries [Verbruggen, Kuik and Bennis]. The issue was requirements for eco-labeling to enter the Dutch cut flower industry. To respond to public environmental concerns about domestic flower production, an industry association developed an eco-labeling scheme that creates segmented flower markets to allow consumers to reward positive environmental performance. These eco-labeling requirements based on national circumstances and preferences have the potential to disadvantage flower imports from developing countries. This case illustrates the difficulty of protecting domestic environmental values without unnecessarily restricting trade opportunities.

All three assessments suggest that present ETMs do not broadly restrict agricultural trade. However, the potential for new ETMs to emerge after other nontariff barriers are phased out under the URA can not be discounted. Conflicts over genetically engineered plants and animals have not surfaced but could well appear in the future [Stanton].

*Do ETMs protect against environmental damages from agricultural trade?*

The other side of the risk-benefit equation is whether ETMs provide effective protection from environmental damages linked to agricultural trade. The key policy challenge is how to implement such trade-related measures to protect environmental values without unduly restricting foreign imports and inducing trade retaliation. The importation of HNIS, one of the largest natural environment risks associated with liberalised agricultural trade, illustrates the complexity of ETM issues.

A comprehensive assessment of the environmental risks from HNIS has recently been completed for the U.S [OTA, 1993]. Over half of the weeds and 40 per cent of the insect pests affecting U.S. agriculture and forestry are estimated to be nonindigenous [Foy; Sailer]. In New Zealand, introduced possums have reached 60-70 million, causing considerable damage to native species and ecosystems (and also pose a risk of trade restriction due to the transmission of disease through meat and dairy exports). Also referred to as "exotic", "alien", "introduced", "non-native" or by other terms, these nonindigenous species can affect both commercial agriculture and the natural environment. Liberalised trade will increase trade volume and, in absence of appropriate policies, open up new pathways for HNIS that pose serious environmental risk [OTA, 1993; Jenkins; Yu].

Although some introduced species, including soybeans, wheat, and cattle, created prosperous agricultural industries, others have caused extensive commercial and environmental damage. Prominent U.S. examples include: Russian wheat aphids, European and Asian Gypsy moths, water hyacinths, and imported fire ants. Of particularly relevance are the 50 to 75 per cent of major weeds that are non-indigenous and cause extensive damage to public and private lands. The invasions of knapweeds and medusahead to western native rangelands and the introduction of melaleuca into south Florida wetlands are examples. Jenkins [1996] notes that approximately 80 per cent of the harmful new exotics detected from 1980 to 1993 in the U.S. were unintentional imports through trade.

The costs of HNIS in the U.S. have been significant. Cumulative economic costs from 1906-1991 caused by 79 HNIS organisms or species cases, less than 14 per cent of the total, was estimated at $97 billion (US$1991). Losses due to exotic agricultural weeds could not be calculated. Estimates of potential future costs for 15 of the very harmful animal and plant diseases range between $66 and $134 billion (US$1991) [Cochran]. The estimates, although inherently uncertain because of incomplete data, likely underestimate actual costs. Damages were unavailable for many cases; some commercial costs

such as private control expenses were infrequently incorporated, and monetary values were incompletely assigned to non-market environmental losses such as declines in recreational fishing. Much of the commercial costs are incurred by agriculture and forestry industries. The environmental costs included declines in indigenous species and transformation of ecological communities and ecosystems, with effects on parks and other areas.

When private parties or public agencies responsible for HNIS introductions are not responsible for paying these commercial and environmental damages, they lack incentives to evaluate new introductions for potential harm.[4] In those cases, the government plays a chief role in regulating HNIS introductions. The SPS code, often used for HNIS cases, sanctions the use of quarantines, for example, to minimise harmful introductions. The U. S. has invoked this provision on a number of occasions: for example, to place restrictions on cut flowers from the Netherlands, and to ban seed potatoes from Canada. Such actions may also be viewed as disguised barriers to trade, and open to challenge under GATT rules. The GATT has rarely been used for such challenges, though, because, as stipulated in Article XX and elsewhere, it upholds a nation's right to establish its own rules and regulations regarding health and safety (which cover NIS). There are, of course, new qualifications to HNIS actions as outlined in the URA's SPS agreement, such as the use of scientific principles.

A review of economic studies showed the benefits of controlling the exotic species exceeded costs usually by a large margin for all but one case [Cochran]. That evidence indicates some remedial policy, either improved screening of trade (and other sources such as tourists), or detection and control after introduction, could improve national welfare. The question relating to agricultural trade is whether to enhance the screening of food and fibre imports that may carry HNIS. One option in that regard is strengthened product standards under the SPS rules. The OTA study acknowledged however that "perfect screening, detection, and control are technically impossible and will remain so for the foreseeable future [OTA, 1993, p.11]." Thus, aiming for a "zero entry" standard would not only be prohibitively expensive, but unrealistic. Setting standards that are too strict may unduly restrict low risk trade, shut out helpful HNIS and may provoke trade retaliation by exporters. Setting standards that are too lax exposes agriculture, other industries, and natural areas to severe losses. The U.S. Congress was urged to direct periodic evaluations of import inspection systems to improve border control systems as one policy option, but the study emphasised domestic actions to foster early detection and control or eradication.

The new URA rules stipulate that member countries will base their SPS measures on international standards (where they exist). GATT encourages harmonisation of standard setting criteria as common principles to avoid unnecessary trade restriction.[5] Exceptions to existing standards are permitted

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4. Some U.S. states do require the deposit of funds to pay expenses in case the non-indigenous species cause damage or require public action.

5. Pearson notes that some in the trade community have historically responded by advocating harmonization of standards whenever possible to avoid barriers and reduce the high costs of selling in fragmented markets. Devices such as the Codex Alimentarius Commission (which aims to harmonize global food and agricultural standards), GATT rules on health, safety, and other technical measures, and regional trade groups like the EU have facilitated harmonization. Potential benefits of harmonization are their minimization as trade barriers and reductions in the high costs of design, production, inventory, and information in selling in fragmented markets with different standards [Pearson]. Potential costs of harmonization stem from differing preferences and abilities across countries to achieve the standards and the transaction costs of negotiation [Marchant and Ballenger]. The balance between benefits and costs will determine the incentives to harmonize any particular set of standards [Krissoff, *et al*].

   Harmonization of natural environment-related product standards may be more complicated because of diverse natural resource and social conditions than for health and safety standards which, in a relative sense, enjoy broader agreement about acceptable levels of human risk. Some environmental groups have

if the countries can scientifically document the need for more stringent standards. Obstacles to establishing standard-setting criteria in the future are clearly formidable, because preferences for certain standards, as well as natural environment conditions, vary greatly from country to country. The assessment concludes "... complete harmonisation of pest risk standards is probably not achievable although agreeing on analytical processes may be [OTA, 1993, p.290]." With the exception of plant movements, international regulations of HNIS were considered weak, but achieving better control of HNIS via the GATT harmonisation processes may not be an easy task.

The study singles out New Zealand's system for controlling HNIS as a model [OTA, 1993]. Like the U.S., higher priority was originally given to protecting commercial agriculture rather than indigenous flora and fauna. The establishment of an Environmental Risk Management Authority in 1996 will if anything tip the balance in favour of protecting indigenous plants and animals. In contrast to the U.S., New Zealand has implemented performance standards for management agencies through contracts, established detailed national standards for animal imports (with strong authority to require bonds for potential losses), and instituted a user pays approach for the costs of inspection and control. Key programmatic aspects include intensive inspections of arriving passengers, baggage and goods, 100 per cent treatment of arriving aircraft with insecticide, and computerised tracking of imports. Decisions to import genetically engineered organisms for example must be subjected to a broad social benefit-cost test including environmental effects. Programme efforts appear to focus on domestic controls rather than trade screening.

In summary, considerable uncertainty still exists about future WTO panel rulings concerning the use of product and product-related process standards for environmental purposes related to agriculture. Improvements in the SPS and TBT codes have clarified some issues but the actions were aimed mainly at food safety and not natural environment issues. Avoiding the "slippery slope" of trade protectionism through "green measures" and mitigating real environmental risks are complex issues. Resolving issues of this scope and complexity will require national and international policy action with strong environmental science input.

## VII. Emerging policy issues

The policy challenges to achieving environmental objectives affected by agriculture without compromising trade liberalisation span three levels: national policies, international trade-related policies and environmental management policies. Current national policies rarely interweave the trade liberalisation and environmental protection goals.

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also challenged such harmonization efforts, arguing they could lead the world's trading nations (all of which have different incomes, environmental concerns, natural resource endowments, pollution assimilative capacities, and thus different desired levels of protection) to adopt the lowest standards possible for the sake of uniformity. Little systematic evidence is available to analyze this "downward harmonization"potential. Indeed, Esty argues just the opposite may occur, citing the Montreal Protocol's effective upward harmonization for phaseout of CFCs [Esty, p.174]. But the strength of upward harmonization forces will likely vary by environmental problem which defines the potential benefits and costs. Despite these difficulties, the OECD's 1972 Guiding Principles state that nations should whenever possible strive to establish harmonized international standards.

### *1. National policies*

*Reform domestic agricultural policies to reduce environmental stress*

OECD countries have repeatedly endorsed this point [OECD, 1993b, 1994c]. Decoupling agricultural support from production levels and specific products is a first step to removing incentives to overapply chemicals, overplant supported crops, convert environmentally-sensitive lands into production, excessively withdraw irrigation water, or exert other environmental stress. However, reform may also lead to land abandonment which may diminish environmental amenities in some regions. Unless the subsidies are tied to environmental performance with benefit-cost disciplines that efficiently provide positive environmental services, trade distortions will follow.

*Target agroenvironmental programmes to significant problems.*

Effective targeting leverages scarce budget resources, lessens unnecessary cost burdens on producers, and reduces trade risks in an era of increasing regulation. Yet many programmes in OECD countries have not been targeted. Political incentives to spread programme benefits across the electorate and scientific/data shortcomings have hindered targeting. But that is starting to change. Pushed by limited budgets and enabled by better science, countries are increasingly using targeted approaches. The nitrate sensitive areas and environmentally sensitive areas (ESAs) in the EU illustrate the shift. In the U. S., CRP enrolments after the 1990 farm bill were guided by potential environmental benefits relative to costs, and further improvements were made in 1996, with the new farm bill. A side benefit of targeting is the improved information base on environmental resources affected by agriculture. Such an inventory helps ascertain if programmes cover significant effects, a requirement for social allocative efficiency.

*Devise agroenvironmental programmes that minimise compliance costs.*

The appeal of the PPP from a trade competitiveness perspective is its internal incentive mechanism to minimise long-term compliance costs by producers. Faced with the responsibility of paying the costs of meeting environmental standards, some cases document that manufacturers have developed pollution control technologies that retain competitiveness [Porter 1990, 1991]. However, applications of the PPP in agriculture are still in the minority [Tobey and Smets]. For social, political and technical reasons, the preferred choice of agroenvironmental policy has been voluntary-subsidy approaches. Although the level of subsidies has been modest, large increases could distort trade if they are not subjected to benefit-cost disciplines. Environmental subsidies, sanctioned in the URA, can be legitimate policy tools depending upon the property rights to the environmental resource in question.[6] They will likely remain the dominant approach in OECD countries for the foreseeable future. Is there a way to minimise their potential distortionary effects? A tripartite strategy has been outlined to move in that direction [OTA, 1995b]:

6. Indeed, the targeted use of subsidies to remedy significant environmental problems disciplined by benefit-cost criteria can be consistent with trade liberalization arguments of including all relevant costs and benefits in the traded good [Kuik and Verbruggen]. For subsidies, the property rights are reversed from the PPP, thus turning environmental costs by agricultural production into benefits for resource users. As noted above, the danger with subsidies, if not targeted precisely and held to minimum compensation, is that they can enlarge the industry's size and increase environmental damages.

- Promote the voluntary adoption of "readily available" technologies that improve environmental conditions and maintain profit (complementary technologies).

- When such technologies are not available, encourage the adoption of the most cost-effective management technologies through subsidies or regulation that achieve the environmental objectives and keep land in production.

- Set aside farmland through cost-effective mechanisms only when agricultural production and environmental objectives are truly incompatible.

Heaviest emphasis would be placed on the first and then second measures to contain private and public costs. Scientific evidence on a suite of complementary technologies is growing, including soil nutrient testing, rotational grazing, conservation tillage, integrated pest management, bio-based pest controls, and organic production [OTA, 1995a,1995b]. Their economic and environmental performances are, however, quite sensitive to local site conditions. Barriers that slow adoption stem mostly from insufficient information and management expertise. Following this strategy would help minimise the upward shift of the supply (cost) curve and any trade effects.

*Invest in agroenvironmental science and technology development.*

Given that remedial environmental policies stimulated by economic growth respond slowly and imperfectly, anticipatory research can be dynamically efficient. That is, an optimal growth path for a country can not be defined without incorporating dynamic environmental shadow prices, thus creating ex ante incentives for investment in environment-conserving technologies. This reasoning lays the foundation for investment in agroenvironmental research and technology development [Ervin and Keller]. Precise quantitative estimates of optimal investment paths are not possible because of missing environmental values. However, existing public and private investment may be presumed deficient because of missing incentives to conserve environmental resources [Ervin and Schmitz]. In the U.S. for example, only about 10 per cent of all public agricultural research has been devoted to natural resource issues, with nearly 60 per cent for productivity enhancement Developing complementary technologies requires that the two research categories be fused. More reliable science will also aid the resolution of trade and environment disputes.

### *2. International trade-related policies*

*Clarify and further develop ETM rules for protection against environmental risks*

Some of the most challenging environmental problems from trade cross country borders. Examples include HNIS invasions, water resources shared between countries, and the destruction of rare and endangered species by production expansion in non-OECD countries. Institutions, such as the CTE and the environmental commission created by the NAFTA, are emerging to address these problems while insuring against unnecessary trade interference. But little evidence exists to foretell their success [Ballenger and Krissoff]. Topical issues include the proper application of product-related process standards for trade in genetically-engineered plants and animals and organic farm products. Early scientific and policy attention to these and other issues could avoid unnecessary trade and environmental risks. First, full support should be given to the CTE's review and decision processes that will speed the clarification of these possible disputes. Two other actions could help ease the uncertainty. National inventories of technical barriers to trade, much as being done in the U.S., would help accurately describe

the nature, extent and degree of environmental interventions. Second, OECD countries could investigate the desirability of establishing a multilateral institution that could provide scientific guidance on the application of ETMs related to agriculture. Not all action needs to be taken by public bodies. Anticipating the growth in trade-environmental issues, the private sector is collectively acting to proactively ameliorate some conflicts. The International Standards Organization (ISO), a private entity serving trading industries around the world, is preparing a set of environmental standards that private firms can follow and improve access to foreign markets. If the firm is certified as satisfying the ISO 14000 environmental standards, they may eco-label their products. The eco-labels also provide consumers with added information with which they can express their environmental preferences in world markets. As a byproduct of seeking ISO 14000 certification, firms have incentives to minimise the compliance costs, and will have added incentives to discover complementary technologies [Batie].

### *3. International environmental management policies*

*Develop institutions to assess international environmental repercussions of liberalised agricultural trade.*

The resolution of transboundary and global environmental problems requires multilateral cooperation. The Montreal Protocol to reduce ozone-depleting substances and the Rio Conventions on climate change and biodiversity illustrate such attempts. Although there are more than 1000 separate international environmental agreements, their overall effectiveness is uncertain. A relatively small number that use trade measures appear to be effective but raise the risk of trade distortions. Preliminary research indicates that cooperative multilateral action with trade sanctions fosters "stronger" environmental standards than unilateral action [Barrett, 1996]. Resolving these transboundary and global issues are costly processes which will take time and come in stages because the environmental science is often weak, management institutions are immature, and multilateral negotiation and collaboration are slow.

A preliminary step could assess the environmental consequences of URA trade liberalisation in OECD countries and beyond their borders that feed back to their interests. Agriculture would be one important element of the review because it uses and affects so much land, water and other environmental resources. Without effective environmental policy and management institutions, serious environmental threats from liberalising agricultural trade are likely to occur in developing countries [Chichilnsky]. Another exercise would assess the need for precautionary assistance to developing countries expected to experience significant agricultural expansion but with little capacity to implement environmental management programmes. Commentators have suggested alternative institutional approaches to these tasks [Esty; Runge, 1994; Young]. For example, a global environmental organisation that folds piecemeal programmes into a more integrated approach to work with the WTO could ensure that economic and environmental objectives are jointly considered.

*Foster private and public agroenvironmental technology transfer*

Environmental technology has become an export growth industry worldwide [OTA, 1994]. Because OECD countries have developed considerable environmental management experience, the capacity exists to work with other countries in evaluating the technology for use abroad. Encouraging a large private sector role in spreading complementary technologies would serve private profit and public interests regarding transboundary and global resources. New technologies, such as integrated pest management, for applying pesticides to minimise negative effects on non-target wildlife species that migrate to OECD countries might be an example. Information-based chemical management also appears to hold potential for application in foreign settings. Two exploratory steps could be helpful. The first would

assemble an international database on trade in agroenvironmental technologies. This exercise would help understand the current trends and obstacles confronting private firms and public agencies, including trade restrictions or burdensome regulations. A second step would convene an international public-private panel on agroenvironmental technology transfer. Both public and private sector participation are necessary to resolve key transboundary and global environmental management questions, such as plant and animal diversity issues.

Throughout the policy challenges, the overarching need for cooperation between OECD countries and with non-OECD nations becomes apparent. Building consistent environmental indicators, inventorying agroenvironmental programmes, assembling science on environmental processes, exploring the development of international environmental institutions, and surveying technologies all exemplify the need. This collaboration will not only improve policy, but will foster mutual assurance among trading partners and help avert growing trade-environment conflicts.

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## ANNEX 1: TRADE - RELATED ENVIRONMENTAL EFFECTS

The environmental outcomes from trade emanate from five types of effects [OECD, 1994a]:

- *product effects* - either positive effects from increased trade in goods that are environmentally beneficial e.g., biodegradable containers, or negative effects from more trade in environmentally damaging products, e.g., hazardous wastes.

- *technology effects* - either positive effects from reducing pollution per unit of product, e.g., precision farming that reduces excess fertilizer use, or negative effects from the spread of "dirty" technologies, e.g., highly toxic and persistent pesticides, through trade channels.

- *scale effects* - negative effects when increased trade leads to more pollution without compensating product, technology or policy developments, or positive effects when increased trade induces better environmental protection through economic growth and policy development that stimulates product composition and technology shifts that cause less pollution per unit of output.

- *structural effects* - changes in the patterns of economic activity or micro-economic production, consumption, investment, or geographic effects from increased trade that either exert positive environmental effects, such as reducing production of crops that rely on chemical intensive methods in favor of more extensive agriculture, or cause negative consequences, such as encouraging the drainage of wetlands to satisfy new trade demands.

- *policy (regulatory) effects* - either improved environmental policies in response to economic growth from enhanced trade or through measures included in the trade agreement, or the diminution of existing policies because of specific trade pressures or restrictions on environmental policy by trade agreements.

The five categories are not mutually exclusive. In particular, note the potential influence of environmental policy developments interwoven throughout the list.

## ANNEX 2: TRADE AND POLLUTION ABATEMENT COSTS

Three themes have emerged from studies of pollution abatement costs (PAC) in non-agricultural industries which generally confront a more stringent set of environmental regulations than agriculture[OTA, 1994].[7]

- *PAC are a small share of the total economic value of final sales on average, especially in comparison to major expenses such as labor*. - Although total PAC expenses more than doubled from the 1970s to the 1990s in some countries, they account for 1.0 to 1.6 per cent of gross domestic product (GDP) [OECD, 1993a]. These estimates come from reports by industrial firms who have incentives to over-report and to under-report actual costs. Over-reporting may stem from attempts by private industry to induce lower regulatory levels and from classifying projects as environmental within firms to gain approval by management. Under-reporting may come from omitted cost items and respondents' lack of knowledge of included costs. The bias is unknown.

- *PAC vary considerably over sectors with a few industries paying large percentages*. - National averages hide considerable variation in costs across industries. Some sectors may experience costs well above the mean value.[8] For example, in U.S. industries such as chemicals, petroleum, pulp and paper, and primary metals, the costs range from 3 up to 15 per cent of value added. With some of these industries disproportionately pulling up the average, the bulk of the remaining industries may be below the mean.

- *Differences in private sector pollution control investments and expenditure (as a per cent of GNP) between OECD countries have declined over time*. - According to recent PAC figures for private and public expenditures in OECD countries, the U.S. is tied with Germany at about 1.6 per cent of GDP, with others in the 1.0 and 1.5 per cent range [OECD, 1993a]. Since 1970, when substantial differences existed, most other countries have increased their pollution control expenditures toward the U.S. and German level. This narrowing of cost differences is consistent with other surveys of agroenvironmental programs across countries [OTA, 1995a].

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7. The key database to test for trade competitiveness effects is the estimated pollution abatement costs (PAC) by private and public sectors in OECD countries [OECD, 1993a]. PAC estimates are regretably not made for the agricultural production sector, except for limited activities such as confined animal facilities in some countries. The technical difficulty and economic cost of accurately collecting data from millions of farms and ranches presumably hinders estimates. Note that analyses of PAC in relation to competitiveness are not intended to judge the social welfare of environmental programs. Such a determination would require estimates of environmental benefits (including any trade advantages) with broader measures of costs (including any trade losses).

8. PAC costs for some industries because of the nature of their production processes and applicable management programs may exceed 5 and even 10 per cent. Examples include petroleum refining, copper smelting, carbon black manufacturing, chemicals processing, and leather production. Note these sectors may generate large and sometimes toxic residuals that require careful handling, reprocessing, and disposal. Therefore their large PAC costs should not be necessarily surprising. Natural questions arise about whether environmental requirements for these sectors could be reformed to promote greater competitiveness.