Working Paper

A Framework for Assessing the Relationship between Trade Liberalization and Biodiversity Conservation

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Prepared for the United Nations Environment Programme

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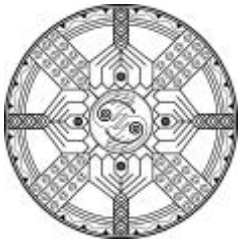

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Executive Summary

This paper develops a framework for assessing the impacts on biodiversity of trade policies such as tariffs, non-tariff barriers and international liberalization agreements. The intended audience is non-economists working on biodiversity policy, who may wish to integrate such macroeconomic considerations in their work.

The framework is described, and applied to two case studies: Papua New Guinea and Indonesia. As predicted in the development of the framework, this application reveals two key limitations: data constraints and the complexity of the linkages. Data constraints are mostly in terms of existing life-cycle analysis (LCA) of products with impacts on biodiversity, but data is also scarce on the *economic* impacts of trade measures. The complexity of the linkages in some cases calls for new methodologies, particularly in assessing the impacts of competitiveness pressures and regulatory constraints on biodiversity.

It is stressed that even in the context of these constraints, the framework is worth applying. The effects of trade in any context are difficult to isolate and quantify, yet governments and international organizations regularly undertake to do so anyway. For a number of reasons, even a partial picture is better than none:

- A partial picture even as limited as that produced by our case studies gives us a general research agenda for better understanding trade's impact on biodiversity. As described above, there is a need for more LCA, more econometric applications, and new methodologies.
- Even with little detailed data, the framework can highlight the key potential areas of concern. These would then become the areas for more in-depth research and careful monitoring.
- Even a partial picture demonstrates the importance of the linkages between trade and biodiversity, albeit without fully quantifying them. The lesson from this is that trade-

biodiversity effects need to be integrated in national biodiversity strategies and action plans, national biodiversity reports, national sustainable development strategies and environmental impact assessments of trade agreements.

1.0 Introduction

This paper develops an analytical framework for assessing the effects of trade liberalization on biodiversity conservation. It aims to provide a tool to help integrate the effects of trade liberalization in the formulation of national biodiversity strategies and action plans, required under the Convention for Biological Diversity (CBD), and of national sustainable development strategies as currently being promoted by the Organization for Economic Cooperation and Development (OECD) Development Assistance Committee. The framework should also be useful for forecasting the possible biodiversity impacts of trade liberalization as part of *ex ante* environmental impact assessments of trade negotiations.

The need for such integration is becoming increasingly clear. As the world's economies become ever more closely linked through international trade and investment, planners at the national level need to understand and take into account the local effects of powerful macroeconomic forces. This is particularly true in the case of biodiversity, where new investment or increased international demand in particular sectors is so often linked to increased habitat destruction, resource depletion and industrial pollution.

While the framework systematically describes the linkages by which trade liberalization can impact on biodiversity, this provides only a first step toward adequately integrating trade in policy making for biodiversity. Applying the framework will require that those linkages also be quantified. For example, assessing the biodiversity impacts of Asia-Pacific Economic Cooperation (APEC)'s Early Voluntary Sectoral Liberalization in the area of forest products demands knowledge not only about how the impacts will manifest, but also about their magnitude. This next step will be difficult, both because of the complexity of the linkages involved, and because of the general scarcity of necessary data. Both of these constraints are discussed in greater detail below.

The contribution of the present work is to give analysts unfamiliar with trade economics a "to do" list of places to look for trade impacts on biodiversity. By categorizing and describing the different types of trade policies and their linkages to biodiversity, the framework shows what research would need to be done, or data collected. Where such data are unavailable, it can alternatively serve to define the research agenda, and to highlight key potential problem areas for monitoring and vigilance.

The framework is developed through three sections that constitute essential steps in our thinking. These sections discuss:

- fundamental concepts regarding the effects of economic activity and public policy on biodiversity. These concepts are important because the effects of trade on biodiversity are often, though not exclusively, indirect. That is, trade induces changes in the economy and public policy which, in turn, have implications for biodiversity;
- broad features of trade policies and trade liberalization agreements to provide essential background for the non-expert; and
- concepts to capture the effects of trade liberalization on biodiversity.

The second part of this paper addresses methodological issues associated with applying the framework, based on its application in two country case studies, for Indonesia and Papua New Guinea (see Appendix A). The case studies are used to assess the usefulness of the framework itself, and to analyze the implications of the two key limitations: complexity of the linkages and scarcity of data.

1.1 Scope of the Framework

The relationships between trade and biodiversity are numerous and complex. In developing a broadly applicable framework, the present analysis focuses in ways that have implications for its scope of application.

First, the framework concentrates on the biodiversity effects of trade liberalization fostered by prevailing broad trade liberalization agreements. It does not attempt an analysis of the specific provisions of trade liberalization agreements, national trade measures, sectoral agreements, or commodity agreements (see Section 3.1.1), nor their specific effects on biodiversity. This type of analysis can be very important, but demands a different level of analysis than is required by this paper's objective. It would lead to analytical frameworks suited to specific categories of agreements or measures and their biodiversity effects. An example would be the possible biodiversity effects of intellectual property agreements such as the World Trade Organization (WTO) Agreement on Trade-Related Intellectual Property Measures. Another example would be common features and related effects of commodity agreements.

Second, the framework does not discuss the trade or trade-related provisions of the Convention on Biological Diversity or the Convention on International Trade in Endangered Species and their relationship to WTO trade rules. This type of analysis has been done, and continues to be done, in other forums;[1] moreover its objectives differ from those of this paper. That body of analysis explores the role that multilateral environmental agreement (MEA) provisions might play in mitigating certain negative effects of trade on biodiversity, or fostering positive effects, and how compatible these provisions are or could be with international trade rules. This paper, by contrast, creates a framework for identifying possible negative effects of trade liberalization without advancing specific suggestions for mitigation.

Third, this paper recognizes that trade liberalization can have both positive and negative effects on biodiversity. Positive effects of trade liberalization can include increasing income levels, which result in increased demand for habitat conservation. Reduced protection of domestic industries often also increases the efficiency with which they consume natural resources such as forests, relieving stress on biodiversity. The analytical

[1] See for example Lesser (1994); Cameron and Makuch (1995); International Institute for Sustainable Development (1996); von Moltke (1996); Nijar (1996), Vaughan (1998) and Houseman *et al* (1995).

framework presented here, however, is primarily focussed on the possible *negative* effects on biodiversity associated with trade liberalization, when accompanying policies and practices do not adequately reflect the value of biodiversity. It is important to recognize that these effects are generally long-term rather than acute.

Fourth, the analytical framework isolates biodiversity conservation as the primary focus for analysis rather than attempting also to address issues associated with sustainable use and sharing benefits of biodiversity conservation. Conservation, sustainable use and sharing biodiversity benefits are three interrelated pillars of the Biodiversity Convention. Biodiversity conservation is severely constrained when sustainable use and sharing benefits issues are not clearly understood and addressed. However, it is possible and informative to isolate conceptually the relationship between trade liberalization and biodiversity conservation without analyzing in detail all the factors that can mitigate or influence the various manifestations of this relationship.

Objectives of the Convention on Biological Diversity
The objectives of this Convention, to be pursued in accordance with its relevant provisions, are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and technologies, and by appropriate funding.

Fifth, the framework develops macro concepts that are comparative and applicable to all countries at different levels of economic development. This inevitably involves a sacrifice of meso or micro concepts for considering effects on biodiversity in specific countries, ecosystems or sectors. These more specific concepts can be developed and refined in different contexts with this broadly applicable analytical framework as a starting point.

2.0 Biodiversity, Economy and Public Policy

The indirect effects of trade on biodiversity arise from trade's effects on the economy and public policy, which in turn affect biodiversity. This section introduces the basic concepts required to understand these primary relationships between biodiversity, the economy and public policy.[2]

2.1 Biodiversity Concepts

In order to analyze the effects of the economy and public policy on biodiversity conservation we first need to answer three questions: "what is biodiversity and biodiversity conservation?", "what values are we trying to conserve?" and "what are the main stresses on biodiversity that we need to consider in our framework"?

Biological diversity means "the variability among living organisms from all sources including, *inter* alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems."[3] An *ecosystem* is "a dynamic complex of plant, animal, micro-organism communities and their non-living environment interacting as a functional unit."[4] *Biodiversity conservation* involves minimizing the loss of genetic diversity, minimizing the loss of species diversity, and minimizing stresses on ecosystems.

Three categories are often used to conceptualize values of biodiversity to humans. These are ecosystem function benefits (indirect use), species or genetic use benefits (direct extractive and non-extractive), and existence benefits. *Ecosystem function benefits* are a very broad category including pollutant filtration, nutrient cycling and climate control. *Biodiversity use benefits* are derived from exploiting species or the genetic properties of species, for example in pharmaceutical production, and from recreational activities such as fishing, bird watching, sport hunting, etc. *Existence benefits* are derived from the

[2] Watson (1995).
[3] See the Convention on Biological Diversity, Article 2.
[4] Id., Art. 2

aesthetic enjoyment of species, the moral satisfaction felt by people in knowing that they have preserved "wildlife", and people's spiritual relationship to nature.[5]

[5] See Resource Futures International (1996).

Figure 1: Elements of Biodiversity Conservation

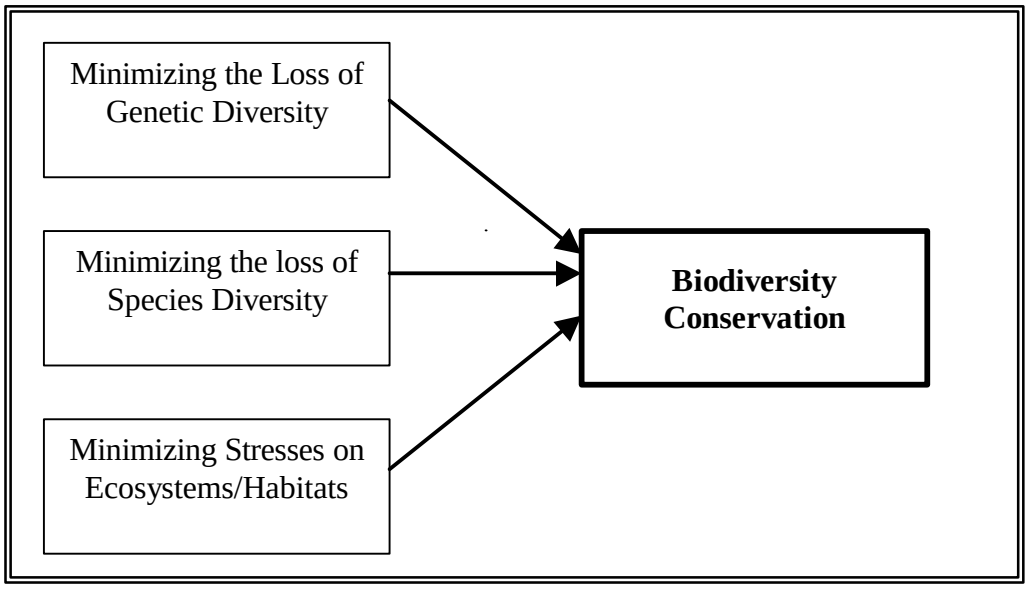
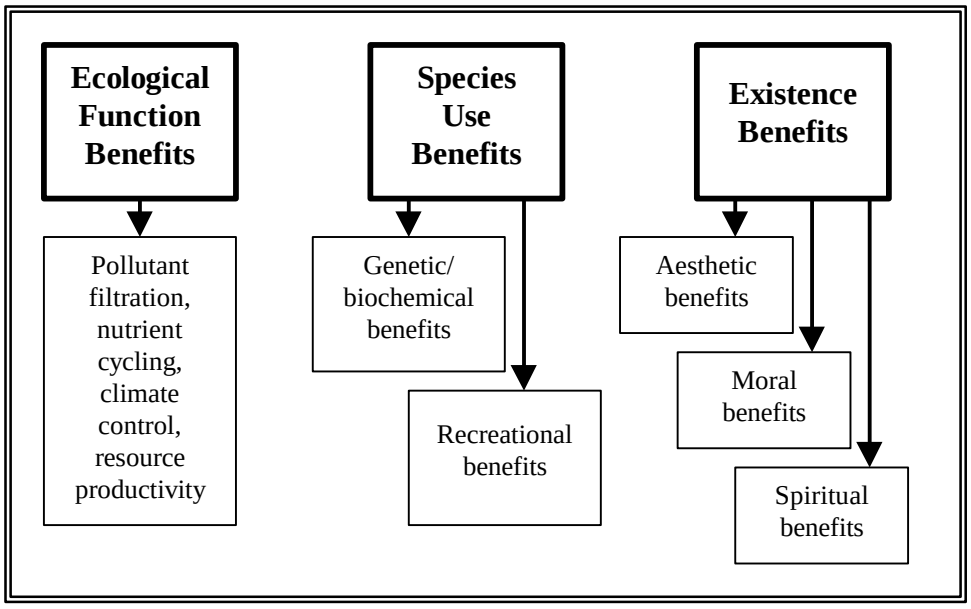
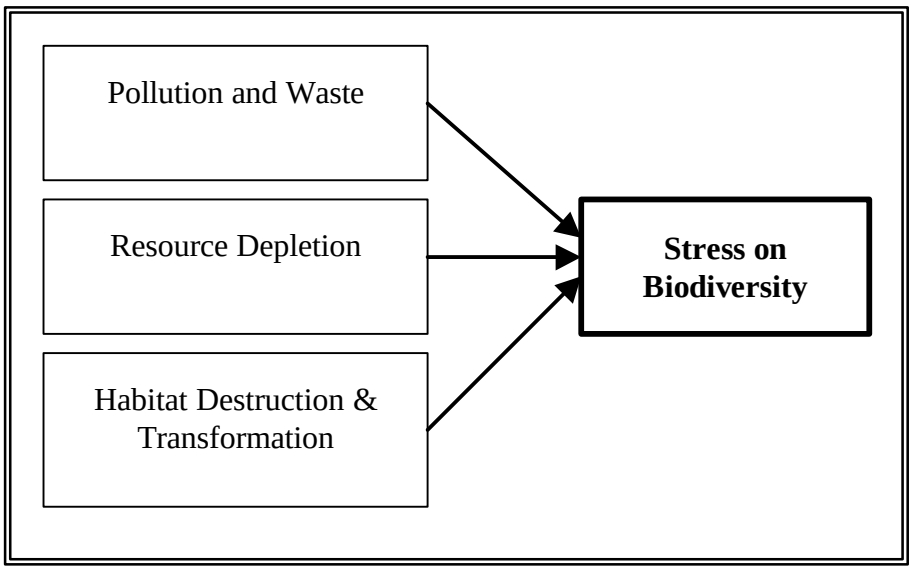


Figure 2: Values of Biodiversity



Stresses on biodiversity conservation can be broadly categorized as *pollution and waste*, *resource depletion* and *habitat destruction and transformation*. The third effect is particularly damaging to biodiversity conservation. Habitat is "the place or type of site where an organism or population naturally occurs." Trade liberalization can elevate each of these stresses through the processes identified in this framework.

Figure 3: Main Stresses on Biodiversity



2.2 Economy and Biodiversity

Economists and biodiversity conservationists tend to agree on one central point regarding the relationship between the economy and biodiversity: damage to biodiversity increases dramatically in the course of economic development until, at a certain level of wealth, opportunities for biodiversity conservation can potentially be improved.[6] There is also strong agreement about the central importance of development for the eradication of

[6] The generalized contrasting of biodiversity conservationists and economists in this section is obviously not applicable in all cases, and is used heuristically. The communities are far from homogeneous, and many analysts actually fall into both categories at once.

poverty. Among its many other terrible effects, poverty is one of the major contributors to stress on biodiversity (e.g. deforestation due to slash-and-burn cultivation practices).

The differences between economists and biodiversity conservationists tend to reside in where they place their emphasis, rather than in fundamental disagreement with each other's points of view. Economists emphasize the contribution of economic growth to providing the resources needed for biodiversity conservation, improving access to environment friendly technologies, and, with increases in standard of living, providing the flexibility societies need to make biodiversity and development trade-offs more favorable to biodiversity conservation. Further, they note the role that trade liberalization can play in improving economic efficiencies by allowing comparative advantage to be realized and economic growth to be enhanced. Biodiversity conservationists, on the other hand, emphasize the potential irreversible damage to biodiversity in the development process prior to a certain level of wealth being achieved.[7] As such, the *precautionary principle* is viewed as essential to biodiversity conservation.

Principle 15: The Rio Declaration on Environment and Development
In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Economists and biodiversity conservationists resume their agreement on the root economic causes of biodiversity destruction. It is generally understood that the prospects for biodiversity conservation would be dramatically increased if the values of biodiversity were reflected in the costs of products and services. Moving towards this objective is complicated enormously by a lack of political and public will, concerns about the sustainability of industries and national accounts in a global context, the current methodological limitations of valuing biodiversity for economic and policy choices, and

[7] Swanson (1994).

the fact that some biodiversity values cannot in principle be priced in the market (e.g. spiritual benefits).[8] The failure to account for biodiversity values is one type of what is known as *market failure*.[9]

2.3 Public Policy and Biodiversity

There are three central points to keep in mind when considering the relationship between public policy and biodiversity.

First, it is important to grasp the *relative significance of public policies.* Generally, a government's environmental policies are an important but entirely insufficient response to the needs of biodiversity conservation. Social and economic development policies often have a much greater influence on biodiversity stresses. For instance, land use policies are far more significant than environmental policies in cases when the goal is to conserve biodiversity in relatively untouched ecosystems experiencing new development pressures. As such, understanding policy influences on biodiversity requires consideration of a range of policies, how well they account for biodiversity values, the coordination between them, and their intended and unintended effects on biodiversity.

Second, *policy failures* explain a lot about biodiversity destruction. The concept of policy failures captures the notion of perverse effects on biodiversity originating in policy choice and design or in policies working at cross-purposes. Policy failures can reside in social policies resulting in poverty-related stresses on biodiversity, various economic, land use and resource policies encouraging biodiversity destruction, and inadequate environmental protection policies.[10]

[8] See Norton (1986), Carson (1994), Diamond (1994, Donato (1995), Haneman (1994) Johansson (1989),World Conservation Monitoring Centre (1997)
[9] See Segerson (1988), Norgard (1987).
[10] See Runge (1993); Warhurst and Isnor (1996); and Johnstone (1995), Wolf (1979).

Third, *international policy formation* has a major influence on domestic policy. For instance, trade, structural adjustment, and foreign debt repayment policies can accentuate domestic economic and land use policies that do not reflect biodiversity values in the development process. They can also create barriers and incentives to policies targeted at biodiversity conservation. Difficulties and opportunities can reside in how well international policies account for biodiversity values, and facilitate, or do not unnecessarily foreclose, domestic policies that could reflect these values.[11]

3.0 Trade Policies and Trade Liberalization

The indirect and direct effects of trade on biodiversity will largely be determined by the types of trade policies that countries adopt, and the relationship of these trade policies to other macro-economic factors, such as national debt, that can accentuate certain trading patterns and relationships.

This section introduces the different types of trade policies that can affect biodiversity conservation. The discussion concludes by identifying the main themes advanced in the recent Uruguay Round of trade negotiations under the WTO. The objective of this section is to provide the non-expert with essential background to understand, identify and categorize trade policies for an analysis of trade and biodiversity relationships.

3.1 Trade Policies

There are four categories of trade policies:

- national measures;
- limited international measures;
- preferential agreements; and
- broad international agreements.[12]

[11] See Toner and Conway (1996).
[12] See Reinstein (1993).

National measures are tariffs and non-tariff barriers imposed unilaterally by a government. *Tariffs* are financial measures imposed on: imports of a particular category of goods (listed in the tariff schedules of the importing country); imports deemed to be benefiting from subsidies in the exporting country (so-called countervailing duties); imports that are deemed to be sold below fair market value (so-called anti-dumping duties); and a wide variety of other taxes and charges imposed on imports for various purposes.

Non-tariff barriers include quotas on goods (i.e. quantitative restrictions), laws, regulations, standards, internal taxes and fees, purchasing requirements, and administrative procedures that place restrictions on imports (e.g. packaging and labeling requirements), and subsidies that favor domestic producers over foreign competition (e.g. agricultural subsidies). A different category of non-tariff barriers are investment rules that place restrictions on trade-related foreign investment.

Limited international measures fall into two categories: sectoral agreements and commodity agreements. *Sectoral agreements* involve two or more countries agreeing to rules that manage trade in a sector to avoid trade disputes between competitors and potentially the application of countervailing or anti-dumping duties by one country against another (e.g. steel, autos and semiconductor chips). *Commodity agreements* are agreements between producers and consumers of a particular commodity to manage the supply of the commodity and, hopefully as a result, avoid volatile swings in market prices and earnings of commodity producers (e.g. coffee, sugar and wheat).

Preferential agreements are tariff concessions offered by one country to another country, generally specifying what products apply and conditions required for the continuance of the agreement. Developing countries are typically the recipients of preferential agreements consistent with General Agreement on Tariffs and Trade (GATT) provisions dealing with "special and differential" treatment to be accorded to developing countries (e.g. the US Caribbean Basin Initiative).

Broad international agreements, involving two or more countries, are aimed at setting broadly applicable rules that apply to tariff and non-tariff barriers. These agreements are widely known as trade liberalization or "free trade" agreements because they have focused on reducing barriers to trade across the board.

3.2 Trade Liberalization

Trade liberalization agreements are the most important category of trade policies when considering the effects of trade on biodiversity because, through the framework of rules they establish, they encourage certain types of trade patterns and limit the use of certain trade and trade-related public policies that might alter these patterns.

The World Trade Organization (WTO), or more properly the collection of agreements administered under the auspices of the WTO, including the General Agreement on Tariffs and Trade (GATT), is the most influential trade liberalization initiative in the world. It has come to set the framework for both national policies and regional trade agreements developed by smaller blocs of countries to formalize the special conditions of their trade. Regional trade liberalization agreements include the European Economic Community, the North American Free Trade Agreement, the Southern Cone Common Market (Mercado Comun del Cono Sud, or Mercosur), Southern African Development Community and the Asia-Pacific Economic Cooperation.

Four main themes were advanced through the recent GATT Uruguay Round of trade negotiations: continuation of traditional trade liberalization objectives, enhanced rules applicable to non-tariff barriers, extension of intellectual property and investment rules, and strengthening of the dispute resolution procedures and the institution of the WTO.

Traditional trade objectives involve advancing the *most-favoured-nation* (MFN) and *national treatment* principles, and *tariff reduction*. MFN requires that the rules (e.g. a tax or standard) applied to one trading partner should not be "less favourable" (i.e. more demanding) than the measures applying to any other member of the WTO. National treatment requires that imported products not be treated less favorably than similar domestic products regarding internal taxes and standards.

The GATT allows Parties to the WTO to adopt measures that are inconsistent with these traditional trade objectives or principles (i.e. measures that discriminate) in certain circumstances that have direct relevance for biodiversity conservation. Article XX, General Exceptions, of the Agreement lists these exceptions, including " measures (b) necessary to protect human, animal and plant life or health; (g) relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption; (j) to address local or world-wide short supply." These exceptions are subject to two disciplines. First, the measures must not be a disguised restriction on trade. Second, the measure must not involve arbitrary or unjustifiable discrimination between countries where the same conditions prevail.

Tariff reduction on an MFN basis has been a central theme of trade liberalization negotiations since the formation of the GATT in 1947 and continuing through the major Kennedy, Tokyo and Uruguay Rounds of negotiations. Recent analyses of the Uruguay Round indicate that tariffs were reduced approximately 38% on industrial products (across the board, calculated on a trade weighted basis) and approximately 36% on agricultural products.[13] However, tariff reductions have typically been uneven. In many sectors of export interest to developing countries (e.g. certain agriculture products, textiles and clothing, leather and footwear, travel goods, cork and wood products, automotive products, and sanitary, plumbing and heating appliances) tariffs will remain higher than the average for all products after the implementation of the agreed

[13] Ocampo (1992), Weston (1996, 1995).

reductions.[14] As such, *tariff escalation* (i.e. the tendency for tariffs to increase for higher value-added products) has not been eliminated as a problem for developing countries.

The Uruguay Round also advanced rules applicable to non-tariff barriers, specifically the agreements on *Technical Barriers to Trade* (TBT), *Sanitary and Phytosanitary Standards* (SPS), and *Subsidies and Countervailing Measures* (Subsidies Agreement). The TBT Agreement addresses mandatory "technical" regulations and voluntary "standards" applying to all products, including industrial and agriculture products. The SPS Agreement applies to all sanitary and phytosanitary measures (food and health standards) that may affect international trade. The Subsidies Agreement establishes rules for the use of most subsidies that can favor domestic producers in trade, and when such subsidies can be countervailed by importing countries under national law or taken to the WTO dispute settlement process.

The TBT and SPS agreements essentially attempt to extend MFN and national treatment principles to regulations and standards. Countries can adopt a wide range of regulations and standards to protect human health and safety, plant and animal life or health, and the environment, as long as these basic trade principles, articulated in various ways in the agreements, are adhered to or not unnecessarily compromised. However, both agreements include an additional obligation that has attracted considerable attention. Countries are encouraged to base domestic regulations or standards on international standards except where no applicable international standard exists, or when international standards would be an ineffective or inappropriate means for the fulfillment of the "legitimate" objectives of the domestic regulation or standard. The SPS agreement, in particular, places an onus on countries to provide scientific evidence to justify deviation from an international standard.

[14] UNCTAD (1994)

The Subsidies Agreement identifies subsidies ("green light category") that are permitted. Among these permissible subsidies is a one-time assistance of up to 20% of the costs to adapt existing facilities to new environmental requirements provided the assistance is directly linked to the environmental issue. Otherwise, subsidies directed at environmental or biodiversity conservation could potentially be countervailed or taken to WTO dispute resolution.

The Uruguay Round agreements on *Trade Related Intellectual Property Measures* (TRIPs) and *Trade Related Investment Measures* (TRIMs) address potential indirect non-tariff barriers. The TRIPs Agreement requires countries to provide and enforce intellectual property protection for products and processes regardless of place of invention, the field of technology, or whether products are produced locally or imported. The TRIPs Agreement has garnered significant attention because it extends intellectual property protection to plant varieties and microorganisms essentially on an MFN basis.[15] However, the Agreement also provides an exception for non-patentability of inventions if there is a potential for serious threat to the environment.

The TRIMs Agreement stipulates that countries should not adopt investment rules that are inconsistent with the principle of national treatment and the GATT restriction regarding setting quantitative limits on imports. The TRIMs Agreement attracted less attention in the immediate aftermath of the Uruguay Round because it is a relatively modest agreement at this point. However, negotiations to broaden and strengthen international TRIMs rules are ongoing in other forums, most notably the OECD (i.e. the Multilateral Agreement on Investment). The initiative of OECD countries would significantly strengthen rules controlling the use of investment laws and regulation that affect trade, and increase pressure for countries to adopt these rules. As a result, we would expect that these rules will come under increasing scrutiny for the role they might play in restricting the capacities of countries to monitor and control investment for

[15] Cosbey (1996).

purposes of advancing biodiversity conservation and domestic ownership over biodiversity resources.

The Uruguay Round strengthened the dispute settlement procedures notably through the creation of a new institutional framework, the WTO, and the adoption of new rules and procedures governing the settlement of disputes. The new rules have stressed strengthening the "jurisprudential" character of the procedure. This mainly involved, "making explicit the ability of panels to hear experts, changes in the procedure for the establishment of panels and the adoption of panel reports (eliminating the ability of parties on one side of a dispute to block either the establishment of panels or the finalization of the procedure), and the creation of an Appellate Body."[16]

4.0 Conceptualizing Effects of Trade Liberalization

This section identifies the various indirect and direct effects of trade liberalization on biodiversity conservation. The three main stresses on biodiversity noted in section 2.1 above and Figure 3, namely *pollution and waste*, *resource depletion* and *habitat destruction and transformation,* are associated with these indirect and direct effects in one or more ways.

The effects of trade on biodiversity should be assessed at three levels:

- the indirect effects of trade on biodiversity through trade's primary effects on economic activity;
- the direct or independent effects of trade on biodiversity; and
- the effects of trade and trade rules on public policy.

The following sub-sections map out in greater detail the specifics of these linkages between trade and biodiversity. At the end of this section is an overview diagram of the resulting framework (Figure 8).

[16] IISD (1996, p. 39).

4.1 Trade's Effects on Economic Activity

The OECD completed work on the effects of trade on the economy, and indirectly on the environment, in the early 1990s.[17] This work led to the development of a conceptual framework that has three elements: product effects, scale effects and structural effects. These concepts can be used for considering the indirect effects of trade on biodiversity.

Product effects are the effects that a trade measure has on a product or a class of products. To assess product effects, it is necessary to characterize a product's effects on biodiversity and the way that the trade measure(s) is affecting the production, transportation, consumption and disposal or recovery of the product (i.e. life-cycle environmental/biodiversity impacts). The effects of a product on biodiversity can be relatively positive or negative. As such, the product effects (on biodiversity) of trade measures can also be relatively positive or negative depending on what product is affected and in what way. Comparatively speaking, product effects are the easiest effects to assess. As such, most assessments of economic and trade effects on the environment/biodiversity tend to gravitate to the product or product/sector level (e.g. agriculture, forestry, and mining).

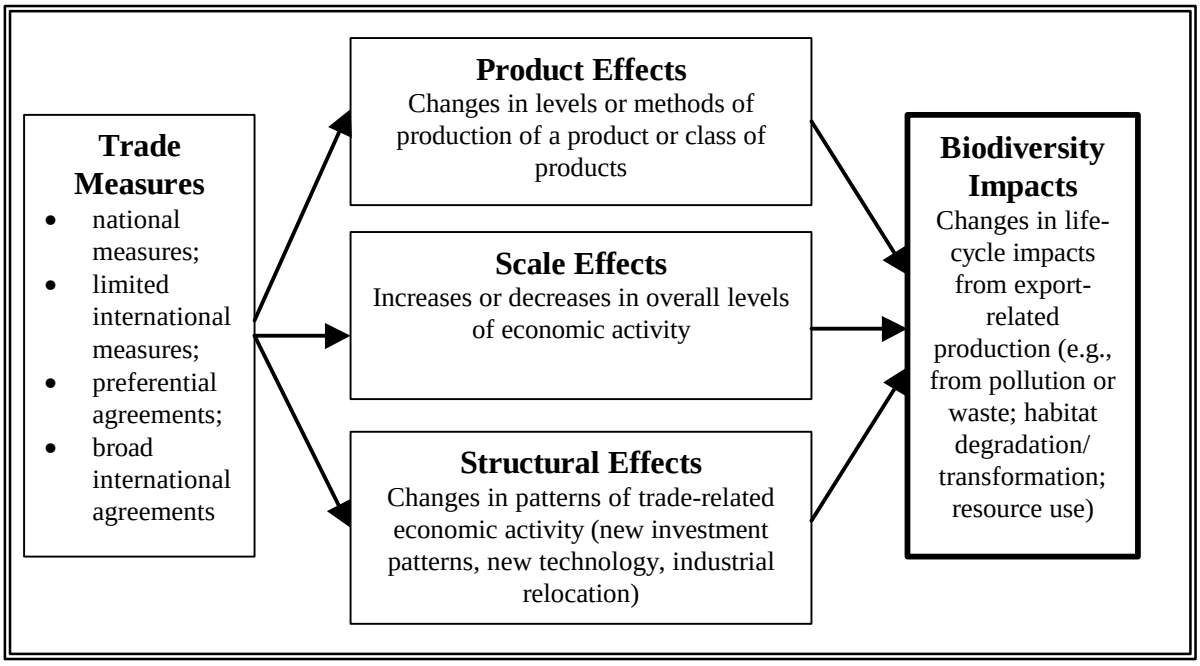
Scale effects are increased effects on biodiversity resulting from increases in the overall level of economic activity stimulated by trade liberalization. Trade liberalization tends to stimulate economies and leads to increases in levels of production and consumption. The three main stresses on biodiversity conservation can be increased in many sectors of the economy when biodiversity values are not reflected in increased production and consumption.

Structural effects are changes in patterns of economic activity stimulated by trade, such as investment patterns, development of new technologies, and significant movements of the production facilities of an industry. As with scale effects, in theory, trade should lead

[17] See OECD (1994a): Commission for Environmental Cooperation (1995).

to increased economic efficiencies in the production, consumption and allocation of resources and thus have a relatively positive impact on biodiversity. On the other hand, if trade policies shift certain harmful forms of economic activity to countries with inadequate environmental policies, the effects on biodiversity could be substantially negative. This often happens as countries attempt to maximize their comparative advantage in natural resources or manufacturing in a global trading context.

Figure 4: Indirect Effects of Trade on Biodiversity



4.2 Independent Effects on Biodiversity

The concept of *independent effects on biodiversity* captures the notion of how conditions created by trade liberalization lead to an intensification of economic activity in certain sectors, overwhelmingly to service international trade markets as opposed to domestic requirements or demand. These sector activities tend to be major contributors to biodiversity loss (i.e. pollution and waste, resource depletion and habitat destruction) in the absence of appropriate policies to protect biodiversity. This notion is closely related to, and could be considered a sub-category of, indirect effects (i.e. product, scale and structural effects), but differs in kind and magnitude based on the total dependence of this category of effects on the conditions (i.e. servicing of global markets) created by trade liberalization, and the tendency for independent effects to significantly transform or distort the local economy.

There are three main conditions created by trade that contribute to independent effects on biodiversity. First, trade liberalization has *rapidly accelerated the cash economy* on a global scale. This has quickly transformed many local economies from production and exchange for local consumption to commodity production for export, and as an extension, to increased reliance on trade and products valued in trading markets. This is known as *commoditization* of the local economy. In part because of the rapidity of this change, public policies, or the capacities to produce public policies, have not kept pace to protect biodiversity and ensure increases in welfare that can be generated by trade liberalization.

Second, trade liberalization has had the effect of *internationalizing investment capital*. Investment capital has expanded access to global natural resources, and can service global markets from almost any location because trade barriers are being reduced on a global scale.

Third, trade liberalization has increased the *spatial separation* of the consumption of products from the environmental and biodiversity costs associated with their production. Most consumers are unaware of the biodiversity consequences of their product choices, and this condition is exacerbated when large distances are involved in the product life-cycle. Institutional and process complexity associated with trying to improve biodiversity conservation is also magnified across jurisdictions. The result is a disincentive to incorporate biodiversity values in the costs of products. This spatial disincentive is more acute when products being exported are price sensitive, and when developing countries experience extreme pressure to maximize exports for macro-economic reasons.

An additional factor associated with spatial separation of production and consumption is increased demands for transportation infrastructure to move products and services. Transportation is a major contributor to stresses on biodiversity (e.g. habitat loss, urban smog, noise pollution, and toxic chemical releases).

These three overarching conditions associated with trade liberalization have contributed to four main trends that pose threats to biodiversity.[18] First, there has been an *intensification of natural resource extraction for export* in many countries (e.g. forestry and mining). The impacts of this on pollution and waste generation, resource depletion and habitat destruction and transformation in the absence of public policies to protect biodiversity are generally understood.

Second, there has been an *intensification of monoculture* in food production for export (e.g. cash crops and shrimp farms). Monoculture increases trade dependencies (i.e. imports are required to satisfy domestic needs while domestic productive capacities service the export market) and results in extreme habitat pressures as land is cleared for cash crop production. Further, recent research points to the complete transformation of ecosystems when a large variety of indigenous crops are displaced by a single crop bringing about the homogenization of natural systems.[19] Ecosystems that were previously characterized by rich biodiversity become characterized by a limited number of species (i.e. the ecosystem itself is tailored to economic specialization).

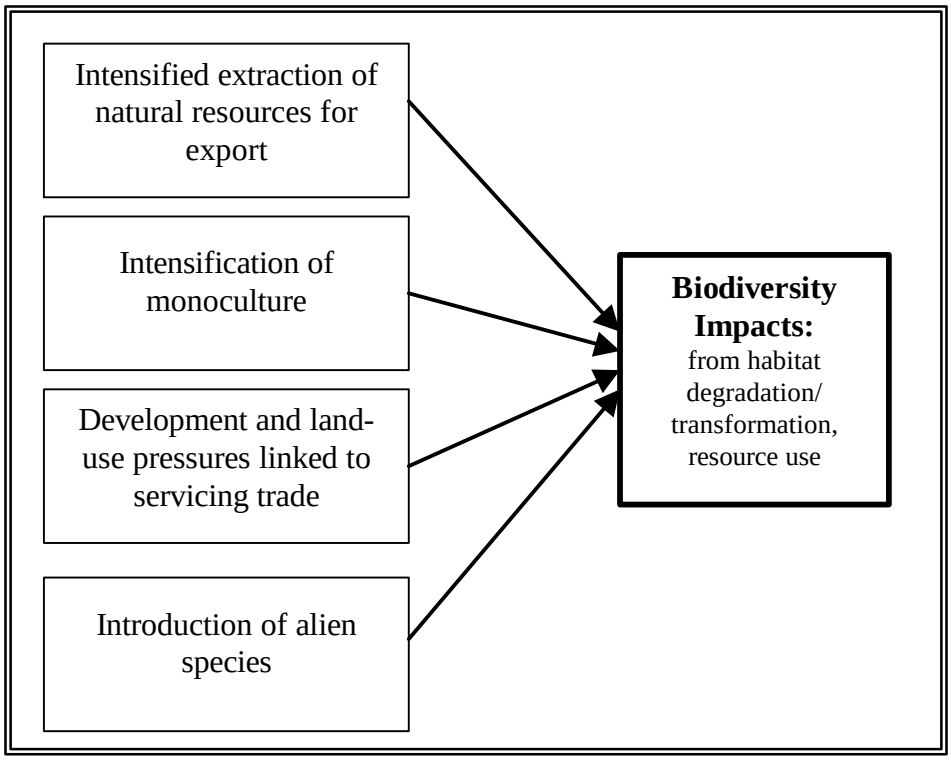
Third, increased economic activity associated with the export market has led to *development and land-use pressures linked to servicing trade*, often without adequate regard for domestic needs and conservation (e.g. transportation infrastructure, border area urbanization, transportation emissions). In these cases the economy may be less directly associated with the natural resource base, but nevertheless completely transforms the local ecosystem (i.e. the Mexican-American border region) based on a trading rationale that inadequately represents or accommodates biodiversity protection.

Fourth, the global movement of goods and services has increased the *introductions of alien species* outside their native range. Alien species, particularly invasive species, can

[18] See Johnstone (1995); Tisdell (1994); Swanson (1994); Norgaard, R. B. (1987).
[19] Johnstone (1995).

have very serious, often irreversible consequences for biodiversity. An invasive species "colonises natural or semi-natural ecosystems, is an agent of change, and threatens native biodiversity."[20] Unintentional introductions of alien species are directly associated with trade and tourism, including: "a) aquatic organisms in the ballast water of ships; b) disease organisms and parasites brought in with authorized introductions; c) hitchhikers on substrates of traded/transported items (water for fish, soil for plants etc); d) insects and other terrestrial organisms on aircraft and ships; e) aquatic organisms dispersed through canal systems." [21] Intentional introductions of alien species are linked to agriculture, horticulture, forestry and aquaculture, including the importation of organisms for biological control purposes. These activities are often intended to service export markets.

Figure 5: Independent Effects of Trade on Biodiversity



[20] IUCN (1996, p. 3)
[21] IUCN (1996, p. 4)

4.3 Public Policy Effects

Trade liberalization agreements establish a framework of rules and encourage trade patterns that affect public policies and, in turn, biodiversity conservation. Broadly speaking, there are three main ways that these effects on public policy are experienced.

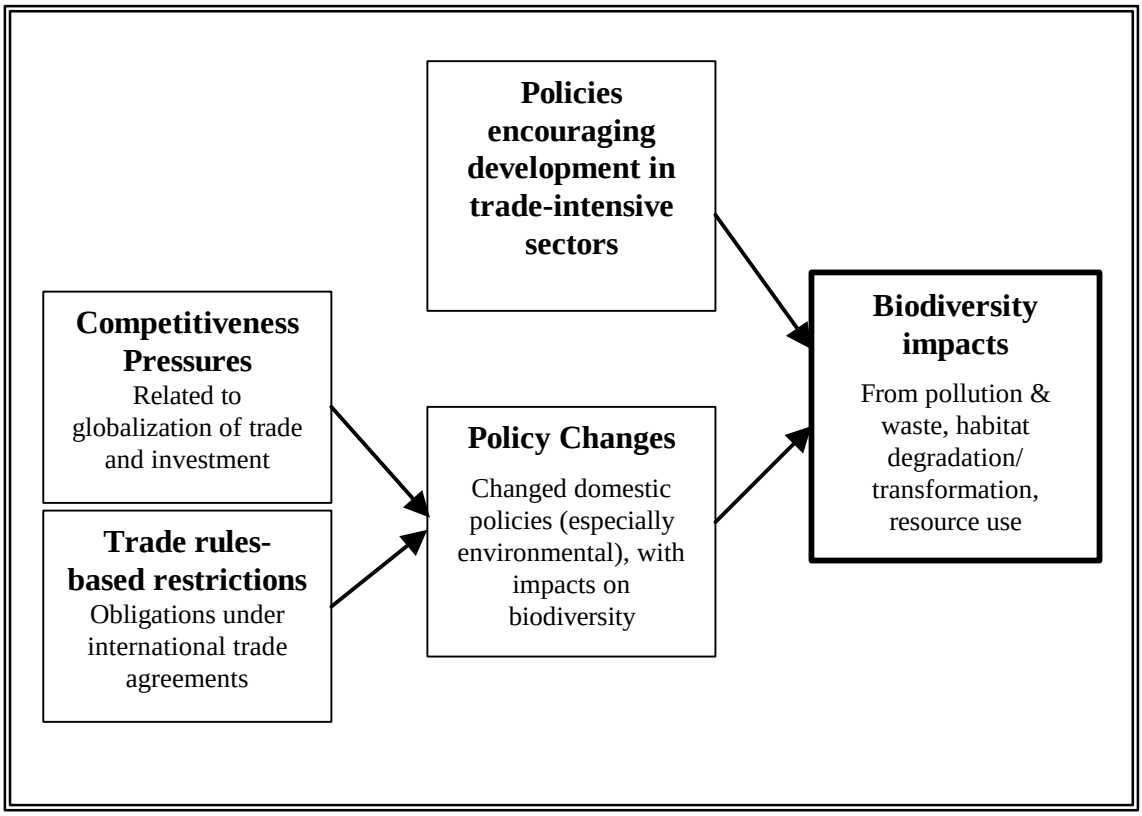
First, trade liberalization agreements increase pressure for *policies that encourage development in trade-intensive sectors.*[22] Often, these policies undervalue biodiversity conservation, particularly in areas of the world where development is at a premium. The desire for countries to encourage investment in their economies is expanded under the competitive market fostered by trade liberalization. Countries are usually eager to attract foreign investment, especially when investors have alternative investment opportunities. Investments often under-represent impacts on biodiversity conservation.

Second, trade liberalization raises the importance of industrial competitiveness to new heights and, as an extension, raises concerns about the effects of environmental policies on competitiveness. This process has become known as *regulatory effects*.[23] This is the tendency not to develop or to delay developing environmental laws or enforcing environmental regulations that might force difficult trade-offs with economic motives.[24] Countries inevitably face a dilemma regarding the effect laws and regulations might have on competitiveness in global or regional markets. Exporting companies, for their part, can encounter a disincentive to undertake environmental investments, because the benefits from trade can be reduced by the production decline from these investments. However, this disincentive can be overcome if the product is not price sensitive, and when production efficiency gains and/or market advantage (i.e. green markets) can

[22] See Tisdell (1994); Warhurst and Isnor (1996), Binswanger (1989), McNealy (1992).
[23] See Toner and Conway (1996); Krutilla (1991).
[24] Note that a number of surveys of the literature (see for example Low and Yeats, (1992), Birdsall and Wheeler (1993), and Duerkson and Leonard (1980)) have failed to find a conclusive evidence for the migration of pollution-intensive industries based solely on environmental regulatory grounds. But none of these looked for enforcement effects, or for the chilling effect on new regulations of competitiveness concerns. And some new research has found evidence of pollution havens, though transient in nature (Mani and Wheeler, 1998).

provide a supporting rationale for assuming the costs associated with environmental performance improvements.

Figure 6: Policy Effects of Trade on Biodiversity



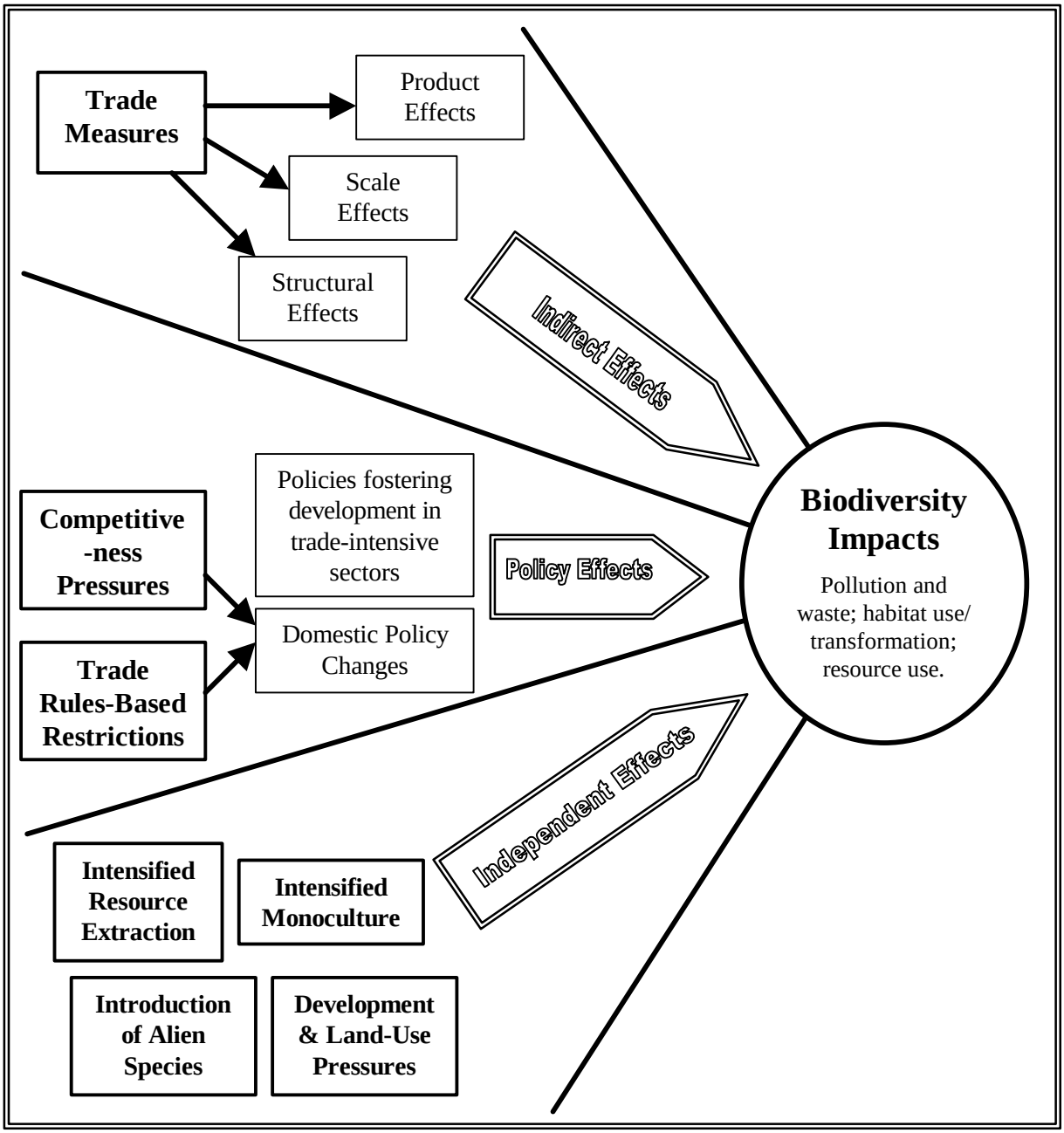
Third, trade liberalization agreements establish certain *obligations not to develop public policies that are inconsistent with trade rules*, except in certain exceptional cases.[25] The effects of trade rules on environmental or biodiversity policies, and the effects of these policies on trade, have been areas of extensive international discussions and documentation.[26] We do not propose to recreate these discussions in this paper. Rather, we pointed to some areas of potential concern in Section 3.1.2 above, when we provided a brief introduction to trade policies and agreements. However, it is also important to understand that these impacts on policy need not be negative for biodiversity, and in

[25] Charnovitz (1993); Harrop (1995).
[26] See Anderson (1992), Charnovitz (1991), IISD (1994), Low (1992) Pearce (1992), Steininger (1994), Young (1994).

some cases can be positive. The elimination of agricultural subsidies in the Uruguay Round may result in examples of this positive effect.

In considering these three factors, we should recall the point made in Section 2.2 that public policies affecting biodiversity will improve as higher levels of development are achieved and public demand for biodiversity conservation increases. However, in many countries, state policy and institutional capacity to render effective latent notional demand for conservation is questionable. The requirement for state policy involvement points to the need to enhance state capacities in developing countries. It also points to the vital role that a viable middle class and democratic institutions will play in making conservation demands. The middle class typically achieves a level of economic wellbeing that encourages expression of environmental values, and yet, unlike extremely wealthy segments of society, lacks the extensive resources required to totally isolate itself from development failing to adequately reflect biodiversity conservation. The poor, of course, have far fewer options to value biodiversity when essential existence needs are not, or only barely, being met.

Figure 7: Overview of the Framework



5.0 Applying the Framework

This section discusses issues associated with applying this framework, and reports on a test application of the framework to two country case studies; Indonesia and Papua New

Guinea. It focuses on two critical limitations in applying the framework: the complexity of the linkages and data constraints.

5.1 Complexity of the linkages

5.1.1 Indirect Effects

Indirect effects manifest through changes in the economy brought about by trade liberalization. Assessing the biodiversity impacts of this type of economic change is a two-step process: first we need to assess the effects on biodiversity of a given product or sector (this usually involves some form of life-cycle analysis), and then we need to quantify the economic change to that product or sector brought about by trade liberalization (i.e., in levels or methods of production). This two-step process varies in difficulty across the three types of indirect effects: product, scale and structural.

The process is most straightforward with *product effects*. It requires first understanding key biodiversity effects in the product life cycle. It then requires estimating the effects that a trade measure has on encouraging, discouraging or transforming the production or consumption of that product. The investment required to gather the first type of information can fluctuate substantially depending on the desired detail and scope of analysis along the product life-cycle. Most analyses of product effects will focus on the effects that are easiest to identify and understand. A trade measure's influence on the production or consumption of a product can be relatively manageable to discern, but this will depend on the type of trade measure and the complexity of the product.

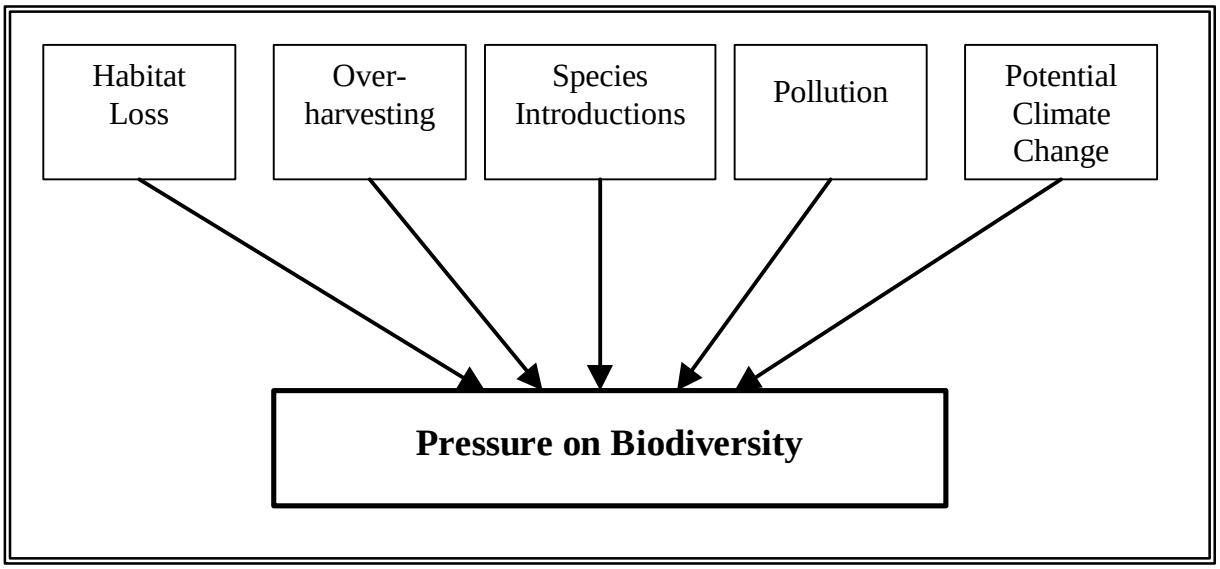
Scale effects and *structural effects* suffer more acutely from the problem of complexity. They occur at a highly aggregated level of the economy where a wide range of complex, interacting factors influence economic events. As such, it is more difficult to isolate the effects of trade measures on scale and structure in performing the second of the two steps in the process outlined above. In response to this limitation, studies of scale and structural effects have tended to concentrate on sector studies where trade's effects on the sector,

and the changed environmental or biodiversity effects of that sector, can be characterized in a somewhat more specific manner. The studies completed by the Organization for Economic Cooperation and Development regarding the effects of trade on the environment are perhaps the best examples of these types of sector studies.[27]

5.1.2 Independent Effects

Independent or direct effects on biodiversity are in general less plagued by the problem of complexity, and are thus more manageable to measure. These types of effects have received the most attention from groups who have undertaken to develop biodiversity indicators. For example, work under the Biodiversity Convention has identified various pressure indicators that closely parallel the independent or direct effects concepts we have identified (Figure 8). [28]

Figure 8: Biodiversity Pressure Indicators



The intensity of resource extraction geared to export, the intensity of agriculture converted to monoculture primarily for export purposes, and the incidence of species

[27] OECD (1994a).

introductions can be measured quite readily if emphasis is placed on assessing these effects in a rigorous manner. Development and land-use pressures linked to servicing export markets is more difficult to measure because of the need to separate these very diverse effects from developments that might have occurred in the *absence* of trade measures; such measurements are not carried out at present. However, recognizable trends such as border area development and transportation infrastructure construction can be assessed at least qualitatively.

5.1.3 Policy Effects

Policy effects present the most difficult challenge for measurement, the linkage between public policy and economic change being highly complex. It is less difficult to assess the linkages in the case of policies encouraging development in trade-intensive sectors. But in the case of competitiveness pressures on environmental policies, or trade rules-based restrictions on domestic policies, we need to measure the effects of an exogenous force on public policies, and *then* the biodiversity effects of the resulting changes in policy. This increased level of complexity makes it extremely difficult to quantify these types of policy effects.

Yet the effects of trade on policy formulation and subsequently on biodiversity are extremely important for biodiversity conservation. We know that the welfare benefits from trade liberalization are likely only to be realized when appropriate polices are in place to encourage reflecting the values of biodiversity in the costs of products and services, and without appropriate policies, biodiversity loss will often be serious. However, we also noted that in some cases trade liberalization will encourage policy changes that will be favorable for biodiversity conservation (e.g. trade rules restrictions on agriculture subsidies).

Research on policy effects will of necessity be highly qualitative and focused on specific policies. However, very little work has been done to establish the methodologies and

[28] Convention on Biological Diversity, Subsidiary Body on Scientific, Technical, Technological Advice, (1997).

indicators for these types of studies despite their importance. Examples of qualitative case studies are: a study of land-use policies to determine whether they are under-valuing biodiversity largely to create conditions for servicing export markets (i.e. emphasis on economic development policies); a study of derogation or non-enforcement of environmental regulations to attract foreign investment or maintain competitiveness in an export dependent sector (i.e. competitiveness pressures on environmental policies); the impact of intellectual property provisions on domestic share of benefits from biodiversity resources (i.e. trade rules based restrictions on domestic policies).

5.2 Data Limitations

There is not much empirical research demonstrating the biodiversity impacts of relevant products over their entire life cycle. This is a fundamental constraint, since it hampers our ability to use the framework to quantify the biodiversity impacts of changes in the economy. Research demonstrating more limited causation (the biodiversity effects of certain forestry practices, for example) is available as a good second best.

There is also a scarcity of applied modeling to tell us what the economic effects of certain trade policies have been at the national level. Nor is there regularly available data predicting the economic effects of various options in ongoing trade negotiations. Both types of data would be needed at a level of detail which would allow us to say, at a minimum, whether production would increase, decrease, or change in the key sectors of interest, as a result of various trade measures.

Lacking such data, the framework can be used only to highlight those areas where significant impacts may have occurred, or where they may occur in future.[29] In such a case it will not be possible to use the framework to quantify specific impacts on

[29] In fact the case studies (see Appendix A) give us just such a picture of key areas of concern, albeit without quantitative estimates of impacts.

biodiversity of trade policy and trade liberalization. That said, this constraint is not as absolute as it may sound, since there will seldom be a complete lack of needed data. Even a partial picture of the key trade-related stresses on biodiversity is better than none.

5.3 Test Application Summary Report

Appendix A provides case studies on Indonesia and Papua New Guinea where we have attempted to apply the framework. These countries were chosen because they are some of the most biologically diverse countries in the world. Our investigation took as the starting point the country biodiversity studies referenced in each case study.

Appendix A documents each instance where we could identify an effect on biodiversity that was consistent with the effects described in this framework. As we would expect, the country biodiversity studies mentioned a range of biodiversity effects reflective of this framework. However, the country studies typically lack trade information (i.e. information on trade policies, trade-related economic policies, and data on product and service exports and imports) needed for the second step of the process outlined in 5.1. Additional trade and other data were assembled from other sources.

For instance, monoculture was mentioned routinely in the country studies, and our conceptual framework suggests that trade liberalization has a major role to play in monoculture, but sector trade data had to be supplied by other sources in order to support this relationship. Similarly, the framework predicted certain sectoral changes that appeared as structural effects or intensified extraction of natural resources for export (e.g. the change from traditional to technologically advanced fishing and agricultural techniques) but the country studies on their own did not provide enough data to make the link back to trade measures.

The weakest area of application of this framework to the two country studies was indirect policy effects, as anticipated in Section 5.1.3. It was difficult to find existing research on biodiversity policies themselves (i.e., how they were affected by competitiveness pressures or by trade-related restrictions), let alone on their end effects in terms of biodiversity.

Direct (independent) effects were somewhat more easily identified, but here too there were some limitations. While the biodiversity effects predicted in the framework were evident in a number of areas, and quantifiable in some, the links back to trade policy are weak. This is because it is challenging to establish causation between trade measures and the relevant changes observed in economic activity. Some of the observed effects (intensification of monoculture, introduction of alien species, etc.) may have occurred even in the absence of any trade measures.

Indirect effects at the product level were similarly identifiable in terms of biodiversity impacts, but similarly difficult to empirically link to changes in trade policy. Data did not exist in sufficient detail to quantify the linkages between trade and biodiversity in the area of scale and structural effects, as predicted above.

The framework did allow us to identify several key problem areas in need of attention in each country. In an in-depth application of the framework these would presumably be the areas where policy makers would focus further research. A more general research agenda can be discerned from the case study applications, as follows:

1. There is a need for new methodologies to assess the impacts of competitiveness pressures and trade rules-based restrictions on domestic policy.
2. There is a need to apply existing methods of economic analysis to determine scale and structural effects of trade measures at the national level.

3. In most cases, there is a need for life-cycle analysis to determine the biodiversity impacts of particular products and sectors.

It is worth asking whether, given the complexity and data constraints highlighted by the case studies, the framework is in fact workable. In the absence of needed data, is a partial application of the framework valid or useful? The answer in both cases is probably yes. The exercise of identifying the effects of trade in any context is plagued by the same sorts of difficulties. Yet governments and multilateral organizations routinely carry out analysis of this type.[30] Despite the difficulties, and even in the knowledge that the results will not be perfect, governments realize that even a partial picture is better than no picture at all.

6.0 Conclusion

This paper has developed an analytical framework for assessing the effects of trade liberalization on biodiversity. We have attempted to demonstrate that trade effects on biodiversity can be indirect, through effects on the economy and public policy, and direct or independent through the unique conditions created by trade. Ten different types of trade effects are identified at a conceptual level to help guide the work of individuals preparing or analyzing country biodiversity studies, preparing country sustainable development strategies, or performing environmental impact assessments of trade agreements. The framework of effects provides one possible analytical tool for a systematic accounting of the relationships between trade liberalization and biodiversity conservation.

We noted that two key factors limit the ability to apply the framework: complexity of the linkages between trade measures and biodiversity, and data limitations. The result of

[30] For an attempt to assess the environmental implications of the NAFTA, see Commission for Environmental Cooperation (1996). For one of many attempts to estimate the economic impacts of the Uruguay Round Agreement, see GATT (1994). For a discussion of methodologies for environmental assessments of trade measures, see OECD (1994b).

attempting to apply the framework in two case studies in Indonesia and Papua New Guinea was a fairly demanding agenda of necessary research, both to clarify the linkages further (as in the case of policy effects) and to provide more empirical grist for the mill (as in the case of direct effects, or indirect product effects).

While the case studies did not result in quantified assessments of the effects of trade on biodiversity, the exercise of constructing the framework and testing it was useful in at least three important ways:

1. As noted above, the data limitations and complexity problems gave rise to an agenda of research necessary to fill in the gaps. While the proposed research agenda is quite general, it is assumed that applying the framework in any particular country would illuminate more specific research needs, as did our case studies in Papua New Guinea and Indonesia.
2. The framework was useful in highlighting the areas in which to look for trade effects on biodiversity. Even without quantifiable results, the case studies were able to pick up some areas where these seem significant enough to warrant in-depth research and monitoring. This type of "broad brush" result would be particularly useful in the context of environmental impact assessment of ongoing trade negotiations, where final trade rule changes are not in any case available as inputs to the exercise.
3. The framework suggests the importance of the trade-biodiversity relationship. The causal relationships argued by the framework, defended here by the literature surveyed, should leave the reader with little doubt as to the need to integrate trade in policy planning for biodiversity conservation. Even with the limited data available to us in the case studies, we can conclude that trade's effects on biodiversity are significant enough to warrant concern. One obvious implication is the need to account for trade and investment effects in national biodiversity strategies and in the national biodiversity reports – a task that this paper aims to make easier. Another is the need for greater efforts to provide technical assistance and capacity building to

those responsible for formulating and implementing biodiversity policy, in an effort to overcome the complexity and data constraints discussed above.

Appendix A: Applying the Framework to Two Country Case Studies

A.1 Indonesia Biodiversity Country Study

Product Effects

"Product effects are the effects that a trade measure has on a product or a class of products. To assess product effects, it is necessary to characterize a product's effects on biodiversity and the way that the trade measure(s) is affecting the production, transportation, consumption and disposal or recovery of the product (i.e. life-cycle environmental/biodiversity impacts)."

The available literature does not provide data on the way that trade measures affect the production, transportation, consumption and disposal or recovery of products or classes of products in Indonesia. Although there is often data on one aspect of a product's life cycle, for most products there are only enough data to suspect a trade measure-related impact on biodiversity. There are not enough data to draw definitive conclusions.

Since the early 1980s, the Indonesian Government has introduced a series of trade reforms. The government announced a major tariff reduction schedule in the deregulation package of May 1995. In the deregulation packages of 1996 and 1997 the Government reduced import and export tariff rates on capital goods, eliminated export and import tariff surcharges for most products, simplified regulation and facilitated exports.[31] This increase in trade liberalization was accompanied by an increase in exports of goods and services from 1, 719 billion Indonesian Rupiah (1973/1983/1993= 100) in 1980 to 111,058 billion Indonesian Rupiah (1973/1983/1993= 100) in 1996. Although there is little information on the impact of specific trade measures on Indonesian biodiversity, trade liberalization has contributed to a drastic increase in natural resource exports. In the absence of conservation and pollution prevention measures this increase in exports may substantially decrease biodiversity through the decline of wildlife populations and critical habitats.

Forestry

[31] Reni Kustiari, Erwidodo and Sjaiful Bahri. *Indonesia's Agricultural Trade Policies: A Review.* ACIAR Indonesia Research Project, Working Paper 97.09, August 1997.

Export taxes on forestry products are classified as a product effect because it a trade measure that has been applied to a class of products and affects this entire class of products. In March 1998 export taxes on logs, sawn timber, and rattan were reduced to a maximum of 10 percent *ad valorem,* and appropriate resource rent taxes were imposed.[32] This is the International Monetary Fund's first step in replacing export taxes by resource rent taxes. In the past, Indonesia had placed prohibitive export taxes on logs and lumber. These measures were instituted by the government in order to increase the development of the value-added or processed wood export industry for products such as plywood, woodworking, moldings, furniture and pencil slat. Indonesia had also exempted the wood slats used to make pencils from export taxes. This provided Indonesian wood processors with an unfair competitive advantage and increased forest exploitation. In Indonesia, only processed products could be exported and exorbitant taxes made domestic log prices much lower than international levels.[33] "It has been estimated that the previous log ban, and the current system of prohibitive export taxes, have lowered domestic log prices by some 40 to 50 percent below international levels."[34] In addition, quasi-cartels and collusive behaviour such as price fixing and intra-firm pricing further reduced the real value of natural logs. This depression of log prices caused extensive overexploitation of forests in Indonesia as Indonesian companies benefited greatly from producing value-added products such as plywood. "The main beneficiary of this policy [high export taxes applied to sawn timber in order to drive raw materials into the secondary sector] has been the plywood cartels which have been provided with a supply of cheap logs."[35] According to the GATT Trade Review Policy, this has caused inefficiencies in mill operations and a

[32] International Monetary Fund. Indonesia -- Memorandum of Economic and Financial Policies, January 15, 1998. http://www.imf.org/external/np/LOI/011598.htm
[33] Thompson, Herb. *Indonesia: Development, Degraded Rainforests and Decreasing Global Biological Diversity.* 1997. (http://forests.lic.wisc.edu/recent/bigindra.txt) AntePodium, published by the Department of Politics at Victoria University of Wellington.
[34] General Agreement on Tariffs and Trade. *Trade Policy Review: Indonesia 1995, vol. 1.* Geneva, February 1995. p. 106.
[35] *Ibid.*

"higher usage of logs for the same production of plywood achieved in other countries."[36] The trade impacts of recent IMF measures to eliminate plywood cartels and replace export taxes with resource rent taxes may result in increased efficiency in Indonesia's forest sector and therefore may have a positive impact on biodiversity.

Rattan is an important forest export product. In 1992 the physical export control of rattan was replaced by high export taxes. This is an example of a trade measure that is intended to help conserve biodiversity. "When Indonesia wanted to conserve rattan, a scarce forest product, the United States and the European Union objected. They argued that the move violated free trade."[37] Although export taxes on a number of products were abolished in early 1998, the International Monetary Fund expressed support for Indonesia's trade measures to protect the supply of rattan: "For other products, however, export taxes cannot simply be eliminated, since they serve as an important means of discouraging overexploitation of Indonesia's natural environment. In such cases, therefore, export taxes will be replaced by resource rent taxes, which would protect the environment, while eliminating the bias against production for export, rather than domestic use."[38] In conclusion, although trade measures in the past contributed to the efficient use of forest resources and may have caused a decline in forestry biodiversity, recent changes in trade measure may help reduce the loss of biodiversity in Indonesia caused by the forestry sector.

Wildlife Trade

Wildlife trade is classified under product effects because the whole class of products can be grouped together. However, there are very few documented trade measures that have impacted wildlife trade. Much of Indonesia's wildlife trade is undocumented or illegal.

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[36] General Agreement on Tariffs and Trade. *Trade Policy Review: Indonesia 1995, vol. 1.* Geneva, February 1995. p. 106.

[37] Pal, Amitabh. "World Trade Organization is Harmful for Environment and Consumer Safety." *The Progressive*, May 13, 1997. http://www.progressive.org/mppal.htm

[38] Reni Kustiari, Erwidodo and Sjaiful Bahri. *Indonesia's Agricultural Trade Policies: A Review.* ACIAR Indonesia Research Project, Working Paper 97.09, August 1997.

Therefore, the available literature does not provide data on the way that trade measures affect the production, transportation, consumption and disposal or recovery of this class of products.

Indonesia is a major exporter of wildlife.[39] Poaching and illegal trade of species such as tigers, rhinoceroses, orangutans and sea turtles is common in Indonesia.[40] For example, the tiger trade involves a well organized, multi-tiered network that starts with poachers on the island of Sumatra, Indonesia.[41] Although tigers have been protected under Appendix 1 of CITES since 1975, at least 14 tigers are lost annually to poaching and pest management.[42] There were once three subspecies of tiger that populated Indonesia. Bali tigers were extinct in the 1940s, Javan tigers were extinct in the 1980s, and there are probably less than 250 Sumatran tigers surviving in fragmented habitat across Sumatra.[43] The IUCN has listed the Sumatran tiger and both Javan and Sumatran rhinoceroses as "critically endangered".[44] In fact, only one hundred and fifty Sumatran rhinoceroses and approximately 40 Javan rhinoceroses remain in Indonesia.[45] A relationship between the illegal export of wildlife from Indonesia and a decline in biodiversity seems to exist; however, quantitative data proving the relationship between trade and this decline in biodiversity is very difficult to obtain.

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[39] Bryant, Dr. Peter J. *Biodiversity and Conservation.* University of California, Irvine. (http://darwin.bio.uci.edu/~sustain/bio65/lec05/b65lec05.htm)
[40] World Wildlife Fund (http://www.panda.org/news/press/news_155.htm)
[41] Earthtrust International (a United Nations Official Non-Governmental Organization Observer) http://www.earthtrust.org/tiger.html
[42] Mills, J.A. and P. Jackson. "Killed for a Cure: A Review of the World Trade in Tiger Bones". A TRAFFIC *Species in Danger* Report by J. Mills, TRAFFIC International and P. Jackson, IUCN Species Survival Commission. http://www.5tigers.org/mills.htm
[43] American Association of Zoo Keepers, http://aazk.ind.net/bfr/UjungKulonTrip94.html and Higley, Keith. "The Market for Tiger Products in Taiwan: A Survey." Earthtrust International. March 1993. http://www.earthtrust.org/tiger.html
[44] see World Wildlife Fund (http://www.panda.org/news/press/new_155.htm)
[45] American Association of Zoo Keepers, http://aazk.ind.net/bfr/UjungKulonTrip94.html

The sea turtle trade in Asia is threatening the viability of these populations.[46] All seven species of sea turtles are listed on Appendix 1 of CITES. The location of these species is circum-tropical and includes Indonesian waters. Species such as the Hawksbill Turtle are critically endangered. In Indonesia sea turtles are threatened primarily by long-term and intensifying trade and shrimp net drowning.[47] Japan consumes nearly all tortoiseshell in international trade and has entered a CITES "reservation" on three sea turtle species.[48] (A "reservation" on a species means that a nation has chosen not to be bound by CITES trade restrictions for the species for which a reservation is made.) Also, non-governmental organizations are monitoring the trade of sea turtles and have reported high tech draw nets set up by Indonesian-Taiwanese joint venture fishing fleets in Indonesian waters that are catching more than 80 sea turtles over a one year period. Data on the volume of sea turtle exports from Indonesia are unattainable. The Japanese CITES reservation, the collection and sale of sea turtle eggs and hatchlings in Indonesia, and joint venture draw net operations in Indonesia provide evidence that Indonesian sea turtles are exported to countries such as Japan and Taiwan and that this trade may be contributing to a decline in biodiversity.

Scale Effects

"Scale effects are increased effects on biodiversity resulting from increases in the overall level of economic activity stimulated by trade liberalization."

Until the recent fall of Asian markets, trade liberalization had stimulated the level of economic activity in Indonesia; however, there is insufficient data and too many confounding factors to correlate this increase in economic activity with any impacts on biodiversity.

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[46] For more information on the trade of sea turtles, see information provided by the World Conservation Monitoring Centre (http://www.wcmc.org.uk/species/data/species_sheets/hawksbil.htm) and http://www.earthisland.org/ei/strp/wtointlaw.html .

[47] Although Indonesia meets the new U.S. law that requires turtle excluder devices on shrimp nets for any shrimp to be sold to the United States, Japan is the largest importer of shrimp in the world. Therefore, not all of Indonesia's shrimp exports necessarily protect sea turtles.

[48] World Conservation Monitoring Centre (http://www.wcmc.org.uk/species/data/species_sheets/hawksbil.htm)

Structural Effects

"Structural effects are changes in patterns of economic activity stimulated by trade, such as investment patterns, development of new technologies, and significant movements of the production facilities of an industry."

Fisheries

The fisheries trade in Indonesia is classified here as a structural effect because of the influence that new fishing technology has on the fishing industry in Indonesia. Local Indonesian fishing fleets are often large wooden boats with draw lights and two way radios, yet foreign vessels such as those of Japanese fleets are loaded with sophisticated satellite tracking devices and other advanced technology. Many foreign fleets such as Taiwanese, Filipino, Hong Kongese and South Korean use high tech satellite/radar tracking systems.[49] The high catches of these fleets threaten the viability of fish populations and consequently the biodiversity of Indonesian fisheries.

Also, high tech draw nets installed by foreign fleets are catching enormous quantities of bycatch including several species that are protected under CITES such as whales, turtles, dugongs and dolphins.[50] This bycatch is usually exported for trade.

In terms of biological diversity, there has been a recent positive development in foreign trade of fish products. A new U.S. law requires turtle excluder devices on shrimp nets for any shrimp to be sold to the United States. Indonesia meets the U.S. standard. The U.S. law prevents the accidental drowning of sea turtles in shrimp trawls.[51] This development may not significantly impact Indonesian fisheries, since "nearly three quarters of export revenue from fishing come from shrimps which are exported mainly to Japan."[52]

[49] Morris, Steve. "Death of the Indonesian Archipelago." S.E.A. Reef Relief. http://www.focus-asia.com/home/fejj/deathof.htm

[50] Rossiter, William. "Fisheries Conservation Crisis in Indonesia". W. Rossiter, President, Cetacean Society International. http://darwin.bio.uci.edu/~sustain/bio65/indonesia/indon97e.htm

[51] Shalal-Esa, Andrea. "US Certifies 39 Nations for Shrimp Imports." May, 4, 1998. http://www.pathfinder.com/money/latest/rbus/RB/1988May04/794.html

[52] Asia Business Network. http://www.abisnet.com/Indonesia_1.htm

Mining

Mining is classified as a structural effect because recent change investment patterns in the Indonesian mining industry may be impacting biodiversity in Indonesia. "There is an impending shift in the sources of metal supply toward the developing world, where many excellent deposits await the right combination of financing, technology and management to enter the ranks of the world's lowest cost producers." [53] In 1996 the London Financial Times stated that mining investment in the Pacific/south-east Asia region showed the largest percentage increase in the world at 61 percent.[54] Furthermore, foreign direct investment approvals in the mining sector in Indonesia increased from 8.2 percent in 1990 to 32.5 percent in 1993.[55] This increase in foreign investment is a structural change, and the biodiversity impacts are therefore classified as structural.

Indonesia now ranks seventh in the world as a gold producer (third in Asia behind China and Papua New Guinea), fifth as a producer of copper and is the fourth largest exporter of thermal coal. It is also the world's largest tin producing country. [56] From 1985 to 1992 the export of ores increased by 100 percent from 1.5 percent of total exports to 3.0 percent.[57] . The Grasberg mine in Irian Jaya, majority owned and controlled by the U.S. corporation Freeport McMoran, Inc., triggered an NGO statement at the second meeting of the Conference of the Parties to the Convention on Biological Diversity held in November, 1995. This huge mine, according to the NGO statement, is causing irreparable damage to the biodiversity of the area. This mine includes an open pit mine with a diameter of two kilometers. Tons of tailings are dumped directly into a river causing flooding, re-routing of rivers, destruction of forests and contamination of

[53] Willson, John. "The Role of Mining in the Evolving World." *Mining Magazine*. February, 1996, pp. 113-114.
[54] Gooding, Kenneth. "Mining Groups Spend Record Sums." The London Financial Times. Oct. 23, 1996.
[55] General Agreement on Tariffs and Trade. *Trade Policy Review: Indonesia 1995, vol. 1.* Geneva, February 1995. p. 48.
[56] Kalimantan Gold Corporation Limited. Vancouver. http://www.kalimantan.com/mining.htm
[57] General Agreement on Tariffs and Trade. *Trade Policy Review: Indonesia 1995, vol. 1.* Geneva, February 1995. p. 11.

fisheries and freshwater biodiversity.[58] The increase in foreign investment in mining in Indonesia has led to an increase in mining operations as well as the environmental repercussions of mining activities. Environmental impacts caused by tailing effluents and land degradation may lead to a decrease in biodiversity. Therefore, it seems that a relationship exists between trade in Indonesia's mining sector and the biodiversity of Indonesia.

Intensified Extraction of Natural Resources for Export

Shrimp Exports

According to the Indonesian Department of Agriculture, the export volume of fishery commodities from 1992 to 1997 increased from 421,367 tons to 636,380 tons, a 51% increase over only five years.[59] The export value of shrimp and other animal products has increased steadily from $313 million in 1988/1989 to $1.7 billion in 1994/1995. "The increased export was primarily brought about by increase in volume despite fluctuating prices of a number of products."[60] This increase in exports involves intensified extraction of natural resources.

From 1993 to 1994 Indonesia's shrimp production increased from 75,000 tons to 100,000 tons, and the number of hectares used for shrimp production increased from 200,000 hectares to 300,000 hectares.[61] Intensive and semi-intensive shrimp ponds exhaust the land's natural resources within 5 to 10 years; consequently, Indonesia abandoned an estimated 800 hectares of ponds in 1994. Most of the abandoned ponds are mangrove swamps that are left totally unproductive. The shrimp aquaculture industry has threatened mangroves, wetlands and other biologically rich or important regions. In Asia, 20 to 50%

[58] For more information, contact: Center for International Environmental Law (CIEL), e-mail cielus@igc.apc.org or Walhi (Indonesia Environmental Forum), e-mail walhi@igc.apc.org. http://net.cs.utexas.edu/users/boyer/fp/biodiversity.html

[59] These statistics were gathered from the Indonesian Department of Agriculture Online "Statistik". www.intracen.org/infobase/itcinfb.htm#statistics

[60] Reni Kustiari, Erwidodo and Sjaiful Bahri. *Indonesia's Agricultural Trade Policies: A Review.* ACIAR Indonesia Research Project, Working Paper 97.09, August 1997, page 12.

of swamp destruction is caused by shrimp aquaculture expansion.[62] The destruction of mangroves is very important to Indonesia's biodiversity, since mangrove swamps form the foundation of the food chain for coastal fisheries and are vital to the ecosystems of Indonesia's marine life.

With the recent financial crisis in Asia, the shrimp industry will likely increase because it is a very profitable business. Also, "many of the ways to construct or manage shrimp ponds that cause the least environmental damage require the importation of costly inputs…. During periods of financial stress, shrimp farmers in other parts of the world have been known to reduce their use of costly inputs, in many cases inputs that reduce their overall environmental impact." [63] Shrimp cultivation also contributes to the depletion of wild fish stocks: 25 to 50% of the content of shrimp feed is derived from captured pelagic fish.

In Indonesia shrimp are one of the leading food exports.[64] Shrimp aquaculture is a rapidly growing industry in Indonesia. In fact, Indonesia has the largest shrimp farms in the world.[65] However, this export is causing intensified extraction of natural resources and a depletion of natural resources. This depletion in mangrove swamps ecosystems, ponds, and pelagic fish is contributing to a loss of biodiversity in Indonesia.

Frog Exports

Trade measures taken in India and Bangladesh may influence frog populations in Indonesia. When frog exports were banned from India in 1987 and Bangladesh in 1989,

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[61] Gujja, B. and A. Finger-Stich. "What Price Prawn? Shrimp Aquaculture in Asia." *Environment.* vol. 38, no.7. September, 1996. p. 33.
[62] *Ibid.*
[63] Clay, Jason. "Indonesia's Currency Crisis and Threats/Opportunities for Conservation". World Wildlife Fund for Nature, February 1, 1998. Draft.
[64] Indonesian shrimp exports fell from 100,455 tons in 1992 to 94,551 tons in 1995 due to disease. Exports began to increase again in 1996.
[65] Clay, Jason. "Indonesia's Currency Crisis and Threats/Opportunities for Conservation". World Wildlife Fund for Nature, February 1, 1998. Draft.

Indonesia became the largest supplier of frog legs to the USA and to Europe.[66] When Bangladesh lifted its ban in 1992, Indonesian frog legs exports dropped from 5630 tons in 1992 to 4912 tons in 1993. In 1997 exports were estimated to return to 5560 tons.[67] Several organizations have established that the wild frog population of Indonesia is seriously endangered; however, factors such as the decline of frog habitats may also contribute to the decline of the frog population. Frog exports from Asian countries may also affect biodiversity through the resulting increase in pesticide use on crops, since frogs are important insectivores. For example, less than 50 frogs are needed to keep an acre of a rice paddy field free of insects. In 1989 Indonesia was using an estimated 25 % more pesticides per year to cope with frog losses. [68] Pesticides can reduce biodiversity of natural flora, as more aggressive, resistant weeds take over.[69] In addition, pesticides negatively affect non-target wildlife through direct poisoning, biomagnification in the food chain, and contamination or alteration of food supplies and habitats.[70] More data is necessary to demonstrate a clear link between frog leg exports and a decline of biodiversity in Indonesia.

Intensification of Monoculture

Monoculture affects biodiversity in three ways: monocultures reduce food crop diversity;[71] monocultures require more fertilizers and pesticides than intercrops, resulting in a loss of biodiversity of insects and non-target species; and monocultures require the clearing of large pieces of land, resulting in a loss of habitat. Indonesia earns substantial foreign exchange by exporting cash crops such as palm oil, rubber and coffee. In fact, Indonesia is the world's second largest producer of palm oil.[72] Oil Palm is a monocrop.

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[66] TED Case Study, http://gurukul.ucc.american.edu/ted/FROGS.HTM, and Phillips, Kathryn. *Tracking the Frogs*, 1994. (unpublished papers)
[67] These statistics were gathered from the Indonesian Department of Agriculture Online "Statistik". www.intracen.org/infobase/itcinfb.htm#statistics
[68] TED Case Study, http://gurukul.ucc.american.edu/ted/FROGS.HTM (unpublished paper)
[69] *Europe's Environment: The Dobris Assessment.* David Stanners and Philippe Bourdeau, ed. European Environment Agency, Copenhagen, 1995.
[70] *Ibid.*, p. 547.
[71] Sekhran, N. and S. Miller, eds. *Papua New Guinea Country Study on Biological Diversity,* Department of Environment and Conservation, 1994. p. 131
[72] Asia Business Network. http://www.abisnet.com/Indonesia_1.htm

In Indonesia the single largest impact of monoculture on biodiversity has been the clearing of land for palm oil plantations. This results not only in forest loss, but recently also results in fires and the consequent long-term loss of large expanses of forest and wildlife. With recent IMF policies intended to expand the Indonesian oil palm sector through the removal of barriers to foreign investment in oil palm plantations, the recurrence and intensification of fires is likely. Current plantations are estimated at 2 million hectares and the Ministry of Agriculture announced that an additional 1.5 million hectares will be added in 1998.[73] Although there is no data on the quantity of biodiversity loss caused by monocropping, it seems reasonable to conclude that monocropping is contributing, through the fires it causes and its other effects, to a loss of biodiversity in Indonesia.

Development and Land Use Pressures Linked to Servicing Trade

The Indonesian forest fires in the fall of 1997 caused a severe loss of biodiversity and were said to be caused in part by land clearing for forestry and agriculture.[74] Although there has been debate around how significant logging and agricultural burning were in causing the fires, it is definite that they were important contributing factors. Other contributing factors included the lack of precipitation in the fall of 1997 and the El Nino.[75]

Some fires were started by small Indonesian farmers for clearing bush for crops. However, many fires were begun by companies who burn the forests after logging to make way for new palm oil plantations.[76] In September, 1997, the Indonesian government listed "176 companies involved in the illegal burning of forests for land clearing purposes, 133 of

[73] Walsh, Kenneth. Environmental Defense Fund, Washington, International Program. 1998. (letter written to Mr. James Wolfensohn, president of The World Bank Group and Mr. Michel Camdessus, managing director of the International Monetary Fund)

[74] "New Indonesian Forest Fires Raise Smog Concerns". Feb. 25, 1997. courtesy of CNN Interactive. http://www.promit.com/d-central/Indonesia_firest.htm

[75] The Washington Post Company, *Letter to the Editor*, Wednesday, October 8, 1997, page A20 (http://washingtonpost.com/wp-srv/WPlate/1997-10/08/0071-100897-idx.html) and *The Gallon Environment Letter*, Canadian Institute for Business and the Environment, Vol. 1, No. 13, October 2, 1997 (http://www.earthsystems.org/list/envtecsoc/0073.html)

[76] "New Indonesian Forest Fires Raise Smog Concerns". Feb. 25, 1997. courtesy of CNN Interactive. http://www.promit.com/d-central/Indonesia_fires.html and Earth Systems Inc. http://www.earthsystems.org/list/forest/0125.htm (unpublished paper) and *The Gallon Environment Letter*, Canadian Institute for Business and the Environment, Vol. 1, No. 13, October 2, 1997 (http://www.earthsystems.org/list/envtecsoc/0073.html)

these companies are plantation estates owners, 28 forest plantations and 15 land clearing companies developing migration settlements..."[77] and "threatened to evoke operations rights of 176 forestry and plantation firms...if they don't submit explanations on the fires on their land by today."[78]

According to the World Wildlife Fund, the fires have resulted in a real threat to some of the region's most vulnerable wildlife and protected areas. The loss of forest resources, such as timber and rattan, and the damage to biodiversity and the health of forest ecosystems, have been severe.[79] In early October, 1997, 11 protected areas in the islands of Sumatra, Kalimantan, Irian Jaya and Java were burning. Threatened species such as the Asian elephant and the Sun bear live in areas affected by the fires.[80] The forestry and agriculture sectors, through their influence on land clearing practices, are two important export sectors that are contributing to a loss of biodiversity in Indonesia.

Introduction of Exotic Species

insufficient data

Policies Encouraging Development in Trade Intensive Sectors

Forest Products and the Agricultural Industry

Policies in the forest products industry and agricultural industry encourage development in trade intensive sectors. In the mid-1980s import and export controls were relaxed to

[77] Earth Systems Inc. http://www.earthsystems.org/list/forest/0125.html (unpublished paper)
[78] *The Gallon Environment Letter,* Canadian Institute for Business and the Environment, Vol. 1, No. 13, October 2, 1997 (http://www.earthsystems.org/list/envtecsoc/0073.htm)
[79] "New Indonesian Forest Fires Raise Smog Concerns". Feb. 25, 1997. courtesy of CNN Interactive. http://www.promit.com/d-central/Indonesia_firest.htm
[80] World Wildlife Fund. http://www.panda.org/news/press/news_155.htm

increase competitiveness and to encourage non-oil exports.[81] For example, subsidies are given to the value-added wood export industry, especially plywood.[82]

The higher growth rates in exports of palm oil, rubber, coffee, shrimp and other animal products during the mid-1990s resulted from a series of trade and investment deregulations taken in previous years.[83] For example, in 1991 licensing restrictions were removed for palm and palm kernel oil, crude palm kernel oil, and copra and copra oil. Prior to 1991 "publicly owned estates were required to market all output through the Joint Market Office (JMO) which allocated oil between domestic and foreign markets."[84] In 1992 Indonesia allowed 100% foreign ownership for investment (in plantation) above $50 million in Eastern Indonesia. In March 1997, trade policy reforms temporarily banned foreign palm oil investment in order to prevent too much land acquisition by foreign plantations. In March of 1998, palm oil export quotas and punitive taxes were eliminated.[85] Instead, palm oil is now subject to export taxes at rates not exceeding 20 percent.[86] This combination of increased tolerance of foreign ownership and the elimination of quotas, licensing restrictions, and punitive taxes will encourage foreign investment in oil palm plantations in Indonesia.[87] Current plantations are estimated at 2 million hectares and the Ministry of Agriculture announced that an additional 1.5 million hectares will be added in 1998.[88] Estimates from the EU indicate that 2 million hectares of forest and non-forest areas may have been burned for plantation agriculture in

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[81] Reni Kustiari, Erwidodo and Sjaiful Bahri. *Indonesia's Agricultural Trade Policies: A Review.* ACIAR Indonesia Research Project, Working Paper 97.09, August 1997.
[82]General Agreement on Tariffs and Trade. *Trade Policy Review: Indonesia 1995, vol. 1.* Geneva, February 1995.
[83] Reni Kustiari, Erwidodo and Sjaiful Bahri. *Indonesia's Agricultural Trade Policies: A Review.* ACIAR Indonesia Research Project, Working Paper 97.09, August 1997
[84] *Ibid., p. 3.*
[85] *Ibid.*
[86] International Monetary Fund. Indonesia -- Memorandum of Economic and Financial Policies, January 15, 1998. www.imf.org/external/np/LOI/011598.htm
[87] For more information on the effects of the IMF and World Bank loan conditions and policies on Indonesia, contact the Environmental Defense Fund, Washington, D.C., Tel. 202 387 3500 or Fas 202 234 5084.
[88] Walsh, Kenneth. Environmental Defense Fund, Washington, International Program. 1998. (letter written to Mr. James Wolfensohn, president of The World Bank Group and Mr. Michel Camdessus, managing director of the International Monetary Fund)

Indonesia in 1997.[89] The biodiversity losses incurred by this increase is unknown, but it can be suspected that this change will increase biodiversity losses as forest is cleared for agricultural lands, monocropping increases pesticide use and food crop diversity is reduced.

Oil and Gas Exports

Since 1989 the government has been encouraging foreign participation in the exploration and production of oil and natural gas through joint-venture arrangements and by incentives.[90] The Indonesian government has been diversifying exports away from oil and gas since the decline of oil prices in the 1980s. Changes in Indonesia's trade structure since 1986 reflect this transition from a country heavily dependent on the oil sector towards a non-oil export based economy. However, oil and gas exports remain an important export for Indonesia. The export value of oil and gas exceeded the value of agricultural exports and the value of forest product exports in 1994/1995.[91] "According to Indonesia's Second 25-Year Development Plan, natural gas production should increase from 7 to 9 billion cubic feet per day."[92] There is insufficient data to prove a direct relationship between biodiversity loss and oil and gas exports, but it seems reasonable to suspect that oil and gas exports contribute to a decline in Indonesian biodiversity. Oil spills reduce wildlife biodiversity, and recently "petroleum pollutants in the form of oil spills, oil slicks and tarballs have become a growing concern in Indonesia."[93] Tarballs become trapped in the root systems of mangroves, leading to mortality of invertebrates, defoliation and death of seedlings.[94]

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[89] Clay, Jason. "Indonesia's Currency Crisis and Threats/Opportunities for Conservation". World Wildlife Fund for Nature, February 1, 1998. Draft.
[90] General Agreement on Tariffs and Trade. *Trade Policy Review: Indonesia 1995, vol. 1.* Geneva, February 1995. p. 109.
[91] Reni Kustiari, Erwidodo and Sjaiful Bahri. *Indonesia's Agricultural Trade Policies: A Review.* ACIAR Indonesia Research Project, Working Paper 97.09, August 1997.
[92] General Agreement on Tariffs and Trade. *Trade Policy Review: Indonesia 1995, vol. 1.* Geneva, February 1995. p. 109.
[93] Link NGO. "Mangroves and Their Characteristics." http://www.lookup.com/Homepages/74468/mangrove.html (unpublished paper)
[94] *Ibid.*

Competitiveness Pressures on Environmental Policies (Regulatory Effects)

insufficient data

Trade Rules-Based Restrictions on Domestic Environmental Policies

insufficient data

A.2 Papua New Guinea Biodiversity Country Study

Product Effects

"Product effects are the effects that a trade measure has on a product or a class of products. To assess product effects, it is necessary to characterize a product's effects on biodiversity and the way that the trade measure(s) is affecting the production, transportation, consumption and disposal or recovery of the product (i.e. life-cycle environmental/biodiversity impacts)."

The Crocodile Trade

The government of Papua New Guinea monitors crocodile populations in order to determine changes in nest numbers, and government policy "is aimed at replacing the trade in skins from indiscriminate hunting, with exports of skins from captive raised, wild caught crocodiles."[95] However, the trade seems to negatively impact biodiversity, since the crocodile populations are being depleted by activities such as exports and habitat destruction caused by other natural resource exports.

Papua New Guinea exports both wild-harvested and captive-bred crocodile products.[96] The sustainability of the trade is questionable.[97] Both species of Papuan crocodiles are currently listed under Appendix II of CITES.[98] (Species listed on Appendix II are not necessarily currently threatened with extinction but could become threatened; consequently, trade in these species is subject to strict regulation.[99]) Although the depletion of crocodiles in Papua New Guinea is restricted by government efforts, crocodile populations and habitats are being depleted by overhunting, logging and mining developments. "A 1994 survey elicited that there is a current danger based on observed trends, that nesting rates may fall to a critical level...resulting in CITES

[95] Sekhran, N. and S. Miller, eds. *Papua New Guinea Country Study on Biological Diversity*, Department of Environment and Conservation, 1994. p. 219
[96] *Ibid.*, pp. 216 - 219.
[97] *Ibid.*, p. 219
[98] *Ibid.*, p. 219
[99] United Nations Environment Programme. CITES homepage. http://www.unep.ch/cites.html

imposing management restrictions on the crocodile trade."[100] Furthermore, it appears that ranching of captive-bred crocodiles is placing pressure on wild populations and contributing to a further depletion of the available wild stock.[101] Trade data shows that the volume of exports of tanned skins, back straps, leather hides, and crocodile meat has increased substantially from 0 skins, 0 back straps, 241 hides, and 0 kg of meat in 1989 to 65 skins, 12 back straps, 607 hides and 645 822 kg of meat and carcasses in 1993.[102] Also, despite ranching, the number of wild crocodiles harvested has increased from 18,300 in 1989 to 25,210 in 1993. [103] It appears that crocodile exports and other natural resource exports impacting crocodile habitat are contributing to a severe decline in crocodile populations and consequently a reduction in the biological diversity of Papua New Guinea.

The Insect Trade

The most popular insects of Papua New Guinea on the international market include butterflies and beetles. Most butterflies in Papua New Guinea are listed on Appendix II of CITES.[104] However, the insect trade in Papua New Guinea, and especially insect ranching, is believed to promote conservation and biodiversity because the economic productivity of the industry relies on the maintenance of healthy ecosystems.[105]

The Papua New Guinea non-profit organization, the Insect Farming and Trading Agency, encourages the wild collection of insects as a cash incentive for rainforest preservation. Though the trade promotes the conservation of biodiversity, the industry needs to be further capitalized and needs to diversify away from the dead specimen trade The insect trade may promote rainforest preservation, but illegal exports of insects and the reduction

[100] Sekhran, N. and S. Miller, eds. *Papua New Guinea Country Study on Biological Diversity*, Department of Environment and Conservation, 1994. p. 219
[101] *Ibid.*, page 219 .
[102] *Ibid.*, p. 218
[103] *Ibid.*, p. 218
[104] *Ibid.*
[105] *Ibid.*, pages 214-216

in insect habitat caused by logging and oil plantation expansion continue to threaten insect biodiversity in Papua New Guinea.[106]

Other Wildlife

Snakes, other reptiles, parrots, lorries and Birds of Paradise are illegally exported for trade.[107] Several of these species are legally protected or recognized as threatened by Papua New Guinean laws, CITES or the IUCN.[108] Trade of these species is probably threatening biodiversity in Papua New Guinea; however, "the volume and value of this trade is unknown." Furthermore, as stated in the Papua New Guinea Country Study on Biological Diversity, "the ability to control trade in wildlife products to maintain species populations is, unfortunately limited."[109]

Scale Effects

"Scale effects are increased effects on biodiversity resulting from increases in the overall level of economic activity stimulated by trade liberalization."

none

Structural Effects

"Structural effects are changes in patterns of economic activity stimulated by trade, such as investment patterns, development of new technologies, and significant movements of the production facilities of an industry."

Forestry

The forestry trade in Papua New Guinea is a structural effect because the inordinate trade of Papua New Guinean wood products has been caused by changes in investment patterns and by the movements of the production facilities of the industry. When Japanese

[106] Orsak, Larry. "Killing Butterflies...to Save Butterflies." Christensen Research Institute, Madang, Papua New Guinea. (http://www.aa6g.org/Butterflies/pngletter.html)
[107] Sekhran, N. and S. Miller, eds. *Papua New Guinea Country Study on Biological Diversity*, Department of Environment and Conservation, 1994. page 217
[108] *Ibid.*, Table 6.2, pages 89-95
[109] *Ibid.*, p. 217

markets opened, Malaysian forests were logged to provide for Japanese buyers.[110] The two Malaysian provinces of Sabah and Sarawak were extensively logged. However, an immense increase in wood processing in the province of Sarawak, Malaysia's export ban on logs from the province of Sabah in 1993[111], and numerous tropical lumber export bans, combined to cause the movement of several Malaysian logging companies to Papua New Guinea. Papua New Guinea is now one of very few remaining Asian countries where tropical log exports have not been banned. Japan is the principle destination for logs exported from Papua New Guinea, importing 60% of Papua New Guinea's logs.[112] Japanese trade data demonstrates a clear link between the changes in the Malaysian forestry industry and increased logging in Papua New Guinea. Japan's tropical hardwood log imports from 1992-1994 show a decrease of 100% in Sabah, Malaysia, a 9% decrease in Sarawak, Malaysia, and a 10% increase in PNG. Logging in Papua New Guinea has increased 400% since 1992. Exports of tropical hardwoods have increased from less than 1 million cubic metres in 1980 to approximately 2.4 million cubic metres in 1993.[113] A single overseas company, Rimbunan Hiaju of Malaysia, dominates exports and is believed to control more than 50 percent of Papua New Guinea's current log harvest.[114]

Logging causes immediate damage to natural forests, and ineffective forest management and logging practices threaten biodiversity.[115] In Papua New Guinea two logging methods are used -- selective logging and clear-fell or clear-cut logging. Selective logging causes damage to residual tree stands thereby threatening the future harvest and potentially resulting in a decrease in species diversity and genotypic diversity.[116] Clear-fell logging is relatively new in Papua New Guinea, so few data are available on its effects. The main

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[110] TED Case Study. http://gurukul.ucc.american.edu/ted/malay.htm (unpublished paper)
[111] Statistics compiled from Nikkan Mokuzai Shimbun, 25 and 27 March 1993; 10 February 1994; 26 May 1994; 16 February 1995; 6 February; 1995; 8 March 1995; and Japan Lumber Reports, 2 April 1995 as shown on the Worldwide Forest/Biodiversity Campaign News homepage. "Japan's Imports of Tropical Timber in 1994: Papua New Guinea Continues to Increase Its Log Exports to Japan" http://forests.org/gopher/japan/japan94.txt
[112] http://www.mcs.mq.edu.au/content/817_1_95/~Elisabeth/LIZ2.HTML
[113] Sekhran, N. and S. Miller, eds. *Papua New Guinea Country Study on Biological Diversity*, Department of Environment and Conservation, 1994.pages 156 and 204
[114] *Ibid.*, p. 52.
[115] *Ibid.*, pages 155, 163, 166, and 205

environmental problems with clear-felling are the loss of topsoil and a complete change in the micro-environment. Industrial logging in areas that are socially and physically unsuitable for logging impedes forest regeneration.[117] Also, Papua New Guinea currently has more than 42,000 hectares of forest plantations. These plantations have resulted in a decrease in biodiversity because fire is often used as a management tool and have not been manually tended or cleaned.[118]

Logging and plantations also impact rainforest fauna; however, there are very few data available on the effects on fauna in Papua New Guinea. There is a problem establishing baseline fauna present prior to logging. Observations by villagers and data obtained by some scientists have indicated that many bird species previously found in a given area are absent after logging. However, "there are almost no data for recovery rates after logging for forest fauna in Papua New Guinea."[119]

The study reports that there is general agreement that the forestry industry poses the greatest threat to biodiversity in Papua New Guinea.[120] Although data on biodiversity losses are unavailable, it appears that trade of wood products (lumber) is threatening biodiversity in Papua New Guinea.

Fishing

Fishing is classified as a structural trade effect in Papua New Guinea because development of new technologies are causing an increase in exports. Artisanal fishing (small-scale commercial) and subsistence fishing in Papua New Guinea involves traditional or low technology whereas commercial/industrial fishing involves large gear, capital intensive operations, products usually aimed at export markets, high catches and mainly foreign vessels.[121] The introduction of new fishing technology has seriously

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[116] *Ibid.*, p. 166
[117] *Ibid.*, p. 205
[118] *Ibid.*, p. 162.
[119] *Ibid.*, p. 162.
[120] *Ibid.*, p. 187
[121] *Ibid.*, p. 170

affected the fishing industry in Papua New Guinea. For example, the tuna fishery has been dominated by foreign interests since the traditional industry culminated in 1985.[122] These foreign vessels primarily use purse seining vessels and occasionally drift nets, two methods that result in a high by-catch of non-target species.[123] In fact, in Papua New Guinea's waters many fisheries and non-target species are in danger of being overfished as a result of highly efficient or non-selective methods of fishing. [124] The Papuan fishery is also subject to illegal fishing by foreign fishing vessels. The increase in fishery exports caused by the use of new fishing technologies, and the change in investment patterns from artisanal and subsistence fishing to foreign commercial fishing, may result in a reduction in the biodiversity of Papua New Guinea's fisheries.

A further threat to fisheries biodiversity caused by trade is the threat of the forestry and agriculture industries in Papua New Guinea. Uncontrolled logging, land clearing for agriculture, and mangrove clearing cause increased run-off, increased sediment loads, and habitat destruction which are detrimental to the biodiversity of fisheries.[125]

Intensified Extraction of Natural Resources for Export

Mining

The Papuan government is extremely dependent on the mining industry for public finances.[126] The mining sector comprised more than 60% of total exports in 1993,[127] and present government policy is aimed at attracting additional capital investment into the sector.[128]

Papuan environmental regulations are inadequate to deal with the environmental effects of mining. In addition, the Papuan government has relaxed environmental regulations for

[122] *Ibid.*, p. 170
[123] *Ibid.*, p. 54
[124] *Ibid.*, p. 182
[125] *Ibid.*, pages 54 and 183-184
[126] *Ibid.*, pages 45 and 55
[127] *1995 International Trade Statistics Yearbook, vol.1, Trade by Country.* New York, 1996. Department for Economic and Social Information and Policy Analysis Statistics Division, the United Nations.
[128] TED Case Study. http://gurukul.ucc.american.edu/ted/ (unpublished paper)

mines such as BHP's Ok Tedi mining project.[129] Citizens in the area of this mining project have reported that the water pollution caused by the mine has resulted in a decrease in bird, fish and turtle populations. Ok Tedi Mining Ltd. and the BHP Bougainville mine are notorious for degrading the surrounding aquatic habitats by the release of waste materials. Although there is little data to prove a direct correlation between a loss of biodiversity in Papua New Guinea and intensified mining for export, evidence suggests that Papua New Guinean mining companies have destroyed habitats, causing threats to aquatic communities, marine and estuarine resources, wildlife populations, and consequently biodiversity.[130]

Intensification of Monoculture

Monoculture affects biodiversity in three ways: monocultures reduce food crop diversity;[131] monocultures require more fertilizers and pesticides than intercrops, resulting in a loss of biodiversity of insects and non-target species; and monocultures require the clearing of large pieces of land, resulting in a loss of habitat.

Agriculture accounts for 14% of export revenues in Papua New Guinea.[132] The vast majority of the population relies on agriculture for their survival and livelihood. Most rural households undertake subsistence cropping, and most of those with access to markets are engaged in some form of cash cropping for export or for domestic consumption.[133]

[129] *Ibid.*
[130] Sekhran, N. and S. Miller, eds. *Papua New Guinea Country Study on Biological Diversity*, Department of Environment and Conservation, 1994. p. 219
[131] *Ibid.*, p. 131
[132] *Ibid.*, p. 47
[133] *Ibid.*, p. 125

Agricultural cash crops are an important export. The major export crops are coffee, cocoa, oil palm, and copra.[134] Coffee is intercropped with shade plants such as bananas, casuarina and leucaena; however, recently there has been a tendency to increase the use of inorganic fertilizers and reduce the use of shade plants.[135] Copra and cocoa are usually intercropped.[136] Oil palm, with more than two thirds produced by large-scale plantations, is monocropped. Rubber, another cash crop, is monocropped.[137] Production of agricultural exports is substantially linked to world prices; therefore, the amount of cash cropping in Papua New Guinea is directly linked to trade[138]. Furthermore, government subsidies provide price support to the four main agricultural export crops (coffee, oil palm, cocoa, and copra).[139] These subsidies reduce interest in crop diversification, contributing to monocultures and intensification.[140]

Monoculture results in greater use of agro-chemicals because monocultures provide ideal conditions for pest infection. "It is widely recognised that herbicides can reduce biodiversity of natural flora, as more aggressive, resistant weeds take over...".[141] In addition, pesticides negatively affect non-target wildlife through direct poisoning, biomagnification in the food chain, and contamination or alteration of food supplies and habitats.[142] Agro-chemical use in Papua New Guinea is correlated with world agricultural export prices. When profit margins decline, agro-chemical use declines.[143] Agro-chemicals are mainly used for export crops and rarely used in the subsistence sector.[144] Therefore, in Papua New Guinea, agro-chemical use is dictated by trade. In other words, an increase in

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[134] *1995 International Trade Statistics Yearbook, vol.1, Trade by Country.* New York, 1996. Department for Economic and Social Information and Policy Analysis Statistics Division, the United Nations.
[135] Sekhran, N. and S. Miller, eds. *Papua New Guinea Country Study on Biological Diversity,* Department of Environment and Conservation, 1994. p.125
[136] *Ibid.*, p.126
[137] *Ibid.*, pp. 125-127
[138] *Ibid.*, p. 132
[139] *Ibid.*, pp. 133-134
[140] *Ibid.*, p. 131
[141] *Europe's Environment: The Dobris Assessment.* David Stanners and Philippe Bourdeau, ed. European Environment Agency, Copenhagen, 1995.
[142] *Ibid.*, p. 547.
[143] Sekhran, N. and S. Miller, eds. *Papua New Guinea Country Study on Biological Diversity,* Department of Environment and Conservation, 1994. p. 136
[144] *Ibid.*

exports of monocultured crops results in an increase in pesticide use, which results in a decrease in biodiversity. Consequently, increases in monoculture cause an indirect trade impact on biodiversity through an increase in the use of pesticides.

Cash crops such as oil palm and rubber are monocropped in Papua New Guinea.[145] "A major issue from a biodiversity perspective is the permanent clearance of forest for plantation agriculture, and particularly oil palm."[146] Cash cropping threatens biodiversity in some parts of the country where increases in population and the requirements for land for cash crops results in the conversion of land from forest to scrub or grassland and the use of more marginal lands for crops.[147] "The conversion of natural forest into forest plantations will always entail the loss of species diversity *in situ*."[148] In addition, in some areas the diversity of planting material has declined as a result of cash cropping.[149] In conclusion, it appears that the increase in cash cropping in Papua New Guinea and the concomitant increase in monocropping is threatening biodiversity of food crops. Also, large-scale agricultural development of cash crops seems to be threatening biodiversity because it results in a destruction of important habitats causes soil erosion, and causes an increase in the use of agro-chemicals.[150]

Development and Land Use Pressures Linked to Servicing Trade

"There is general agreement that the most significant threat currently posed to Papua New Guinea's biodiversity values stems from the degradation of terrestrial habitats by total or partial removal of natural forest cover." This type of threat takes three forms: permanent natural forest clearance for economic purposes; forest damage by selective logging; and shifting cultivation to portions of natural forest not previously cleared for this purpose.[151]

[145] *Ibid.*, pp. 125-127
[146] *Ibid.*, p. 48
[147] *Ibid.*, p. 131
[148] *Ibid.*, p. 161.
[149] *Ibid*. p. 131.
[150] *Ibid.*, p. 136
[151] *Ibid.*, pp. 187-188

Agriculture

Land use pressures related to agriculture is a serious concern. It is estimated that between 150,000 hectares and 200,000 hectares of forest is cleared annually for agriculture.[152], Major export crops such as oil palm are monocropped on plantations, and "there is a trend to incorporate large-scale agricultural plantations which require clear-felling into forest development plans to enable companies to increase their permitted cuts. The size of the proposed areas for such plantations in 1994 is already almost double the total area subjected to clear-felling for forest purposes."[153] Most of these plans are for the forest type in Papua New Guinea that is likely to be the richest floristically and are located inside an area of high to very high priority for biodiversity conservation. Forest clear-cutting for some agricultural projects can potentially cause *in situ* as well as *ex situ* environmental impacts because of the location of the cutting. For example, clear-cutting close to the watershed of the major rivers increases the potential for *ex situ* impacts on river deltas and their mangrove vegetation.[154]

Forestry

Both selective and clear-cut logging converts forest land to grassland, particularly on steep ridges and cleared slopes.[155] Also, logging operations in forests that overlap with the Conservation Needs Assessment priority areas (1.5 million hectares) may severely affect the priority areas.[156] Selective logging damages the remaining trees, causing serious degradation of the forest. This results in a loss of biodiversity as well as a loss of genotypic diversity.[157]

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[152] N.Sekhran, W. Ginn, F. Arentz, G. Gresham, M. Hedemark, and R. McCallum. *Papua New Guinea Biodiversity Conservation and Resource Management Program*, Department of Environment and Conservation, Papua New Guinea and UNEP, 1996.
[153] Sekhran, N. and S. Miller, eds. *Papua New Guinea Country Study on Biological Diversity*, Department of Environment and Conservation, 1994. p. 163.
[154] *Ibid.*, p. 163
[155] *Ibid.*, p. 161
[156] *Ibid.*, p. 162
[157] *Ibid.*, p. 166

Mining

Land use intensification caused by large-scale mining operations increases local pressures on biodiversity resources such as forests which are cleared for mining infrastructure (facilities, roads, etc.).[158] This may contribute to a decrease in biodiversity.

Introduction of Exotic Species

Several exotic species of fish, plants, insects, birds and mammals have been introduced in Papua New Guinea. These species present a major economic threat.[159] The introduction of 26 exotic fish species has negatively affected native species through competition, preying on native species or habitat destruction.[160] Several insect species were introduced for biological control of agricultural pests and weeds.[161] Introduced species may alter habitats to such an extent that native species are unable to survive.[162] Therefore, it is quite likely that the introduction of exotic species has reduced the biological diversity of Papua New Guinea; however, insufficient data exists to determine whether the introduction of exotic species is linked to trade.

Policies Encouraging Development in Trade Intensive Sectors

The Papuan government has instituted policies for encouraging development in the insect trade, agriculture and mining sectors. The government set up the Insect Farming and Trading Agency in order to develop the insect trade.[163] The potential for this trade to have a positive effect on biodiversity was explained in the section on product effects. Government subsidies provide price support to the four main agricultural export crops (coffee, oil palm, cocoa, and copra). Present government policy is aimed at attracting

[158] *Ibid.*, pages 55 and 187
[159] *Ibid.*, p. 77
[160] *Ibid.*, pages 184 and 78
[161] *Ibid.*, pages 78, 81 and 82
[162] *Ibid.*, p. 79
[163] Orsak, Larry. "Killing Butterflies...to Save Butterflies." Christensen Research Institute, Madang, Papua New Guinea. (http://www.aa6g.org/Butterflies/pngletter.html)

additional capital investment into the mining sector.[164] For example, when copper prices fell in the mid-1980s, the Papuan government sought increased copper production.[165] The impacts of the agricultural sector and mining sector on biodiversity were described in previous sections.

[164] Sekhran, N. and S. Miller, eds. *Papua New Guinea Country Study on Biological Diversity,* Department of Environment and Conservation, 1994. p. 55
[165] TED Case Study. http://gurukul.ucc.american.edu/ted/ (unpublished paper)

Competitiveness Pressures on Environmental Policies (Regulatory Effects)

The Papuan government has relaxed environmental regulations for mines such as BHP's Ok Tedi mining project.[166] The environmental effects of this mine contributing to a loss of biodiversity are described in the section on Intensified Extraction of Natural Resources for Export.

Trade Rules-Based Restrictions on Domestic Environmental Policies

Insufficient data

[166] TED Case Study. http://gurukul.ucc.american.edu/ted/ (unpublished paper)

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