WORLD TRADE ORGANIZATION

RESTRICTED

WT/CTE/W/67

7 November 1997

(97-4873)

Committee on Trade and Environment

ENVIRONMENTAL BENEFITS OF REMOVING TRADE RESTRICTIONS AND DISTORTIONS

Note by the Secretariat

1. This Note has been prepared in response to the request by Members of the Committee on Trade and Environment (CTE) for background documentation to assist the discussion of the second part of Item 6, namely the "environmental benefits of removing trade restrictions and distortions". It builds on the 1996 Report of the CTE to the Ministerial Conference WT/CTE/1, and previous Secretariat documentation, including WT/CTE/W/1 and WT/CTE/W/25. In the 1996 Report of the CTE, Members expressed an interest in undertaking further work to broaden the analysis of the potential environmental benefits of removing trade restrictions and distortions in specific sectors. It is considered that trade liberalization in these sectors has the potential to yield benefits for both the multilateral trading system and the environment.

2. This Note is organized as follows. The introduction addresses some general considerations concerning the relationship between removing trade restrictions and distortions and the ensuing environmental benefits. This section of the Note builds on WT/CTE/W/1, which sets out the links between trade liberalization and the environment. In order to bring some specificity to the discussion at the sectoral level, the remaining sections then address the relationship between removing trade restrictions and distortions and environmental benefits in the following sectors: agriculture, energy, fisheries, forestry, non-ferrous metals, textiles and clothing, and leather. The discussion of each sector is divided into three parts. First, there is an overview of the main characteristics of the sector; second, the most prevalent trade restrictions and distortions are discussed; and third, the environmental benefits associated with the elimination of these trade barriers are examined.

I. INTRODUCTION

3. Identifying the economy-wide and sectoral effects of trade liberalization is in itself a complex task. Establishing the relationship between these effects and the related environmental benefits is even more complex. The 1996 Report of the CTE recognizes that trade liberalization, including the elimination of trade restrictions and distortions, can yield developmental and environmental benefits by facilitating a more efficient allocation and use of resources (paragraph 197). Further, it is generally accepted that in order for these benefits to be realized, and for trade-induced growth to be sustainable, appropriate environmental policies determined at the national level need to be put in place. It should be kept in mind that trade liberalization is not the primary cause of environmental degradation, nor are trade instruments the first-best policy for addressing environmental problems. The most significant part of the relationship between trade liberalization and the environment passes indirectly through effects on levels and patterns of production and consumption. Therefore, the environmental benefits of removing trade restrictions and distortions are also likely to be indirect and not readily identifiable in general terms. This is particularly the case for trade policies as they are but one of several areas of policy-making that have an effect on economic activity.

4. The basic premise of this Note is that in well-functioning market-based economies, prices register the relative scarcity of resources and consumer preferences; their role is to, *inter alia*, allocate resources efficiently.[1] The welfare of society can be undermined, however, when market prices fail to capture the effects of environmentally-damaging activities and therefore send misleading signals relating to the optimal use of environmental resources. Resource misallocation undermines effective environmental management.[2] Distorted prices can obscure the abundance of under-utilized environmental resources, contribute to the excessive depletion of exhaustible resources, generate new environmental problems, and contribute to the excessive use of environmentally-damaging inputs.

5. From an empirical perspective, many studies have demonstrated a positive correlation between liberal trade regimes, higher productivity and more efficient allocation of resources, and that open, outward oriented economies have grown more rapidly than closed, inward-looking ones.[3] This translates into fewer resources being required for a given output and a higher level of income from which to draw resources to protect the environment. Thus, trade liberalization has the potential to have a twofold positive effect on the environment. Influencing factors will vary across countries, depending on the stage of economic development of the country concerned, the nature of the policies pursued and the prevailing market conditions. In this regard, paragraph 198 of the 1996 Report of the CTE notes that further work on this Item in the CTE should take into account different country-specific natural and socio-economic conditions and the specificity of the sectors involved.

6. For the purposes of the sectoral analysis which follows, the relationship between trade liberalization and environmental benefits can be divided into two categories. First, there are general environmental benefits which flow from an increase in per capita income. There is wide agreement concerning the close linkage between poverty and environmental degradation. The 1996 Report of the CTE notes that "[e]mphasis has been placed on the importance of cooperation in the essential task of alleviating and eradicating poverty in order to achieve sustainable development and the role that increased trade and market access opportunities can make in this regard" (paragraph 196). Principle 5 of *the Rio Declaration* also refers to the task of eradicating poverty as an indispensable requirement for sustainable development. In addition, extensive reference is made in Chapter 2 of *Agenda 21* to the contribution trade can make to this objective by raising income levels.

7. The 1996 Report of the CTE acknowledges the contribution of the prompt and full implementation of the commitments made in the Uruguay Round. The income-creating effects of the trade liberalization as a result of the Uruguay Round have been estimated to be of an order of magnitude of up to

---

[1]There is rarely an unambiguous relationship between the removal of trade restrictions and relative price changes. Some price increases may be absorbed by producers, while many other parameters (demand and supply elasticities, etc.) also need to be taken into account in determining final price levels.

[2]The relationship between price distortions and the environment has been analyzed extensively and forms the basis of environmental economics. *See*, for example, D. Pearce and K. Turner (1990), *Economics of Natural Resources and the Environment*, Baltimore; M. Cropper et. al. (1992), "Environmental Economics: A Survey", *Journal of Economic Literature*, Vol. XXX; T. Panayotou (1993), *Green Markets*, San Francisco; R. Repetto (1994), *Trade and Sustainable Development*, UNEP Geneva; D. Bromley (1995), *Handbook of Environmental Economics*, Oxford; S. Fauchex et. al. (1996), *Models of Sustainable Development*, Oxford.

[3]*See*, for example, M. Michaely (1977), "Exports and Growth: An Empirical Investigation", *Journal of Development Economics*, Vol. (4).1; A. Krueger (1978), *Foreign Trade Regimes and Economic Development*, Cambridge; IMF (1993), "Trade as an Engine of Growth", in *World Economic Outlook*, Washington; J. Lee, *International Trade Distortions and Long-Run Economic Growth*, IMF Staff Papers, No. 40, Washington: World Bank; G. Harrison et. al. (1995), "Quantifying the Uruguay Round", in W. Martin, ed., *The Uruguay Round and the Developing Economies*, Discussion Paper No. 307, Washington: World Bank.

US$510 billion per annum.[4] The level of per capita income necessary to realize environmental benefits varies depending on not only the sector and country concerned, but also the indicator of environmental quality employed, the general proposition remains that environmental benefits can be linked to income growth.[5]

8. Second, there are environmental benefits associated with the removal of specific trade restrictions and distortions and the more efficient allocation of environmental resources. These are set out in the sectoral analysis that follows.[6] An underlying problem when making any generalizations about the environmental benefits which may flow from the removal of trade distortions is that, due to the absence of comprehensive environmental valuation techniques, it is difficult to make inferences about net environmental benefits from an economy-wide perspective. Moreover, removing trade restrictions and distortions is rarely synonymous with an unambiguous improvement in environmental quality *per se*. As the sectoral discussions below suggest, while removing a trade restriction or distortion may be an important pre-condition for improving environmental quality, its removal is not in itself a guarantee of improved environmental quality.

9. Three general categories of environmental benefits are identified in what follows. First, there can be absolute or relative improvements in environmental quality (See Annex). Examples include a reduction in the overall level of pollution intensity, a reduction in the degree or per unit level of effluent toxicity, a reduced rate of depletion of a scarce resource, an increased rate of resource replenishment, or a decline in the rate of species extinction. Measuring different types of environmental benefits is difficult, given the complexities involved in quantifying them. For example, few environmental goods or services are exchanged in the marketplace; indeed the core assumption of environmental externalities is that environmental costs and benefits occur outside the market framework. Approaches to integrating environmental values in pricing schemes include assigning values based on measuring market behaviour and creating surrogate markets.[7] In order to improve the measure of

---

[4]The range of US$109 to US$510 billion per annum represents 0.31 to 0.86 per cent of global GDP. However, most studies emphasize that such estimates underestimate the expected gains from the Uruguay Round for three reasons: (a) a number of dynamic effects leading to efficiency gains are not included; (b) failure of the Uruguay Round would have led to a worsening of international trade relations; and (c) such estimates do not include gains in other areas of the Round, including the market access commitments of trade in services, and the strengthening of the WTO rules. The GATT Secretariat estimates that the increase in the volume of world trade in goods ranges from 9 to 24 per cent once liberalization is fully implemented, representing gains in the range of US$244 to US$668 billion. *See* GATT (1994), *The Results of the Uruguay Round of Multilateral Trade Negotiations*, Geneva.

[5]Several studies have addressed the environmental consequences of income growth, and have suggested an inverse relationship (an environmental Kuznet's curve) between growth in per capita income and the intensity of some polluting effluents. Three patterns of income-pollution intensity coefficients have been identified by the World Bank: (a) some environmental problems - such as a scarcity of potable water or inadequate sanitation - decline as income rise; (b) some environmental problems - like particulate and sulphur dioxide pollution emissions, deforestation or the loss of natural habitat - initially worsen, but then improve as income rise beyond a certain per capita income level; and (c) some environmental problems - including carbon dioxide and nitrogen oxide emissions - worsen as income increases. It should be noted that correlations are also determined by changes in composition of output (structural change), changes in technologies, and changes in policies. *See*, for example, T. Panayotou (1993), *Empirical Tests and Policy Analysis of Environmental Degradation at Different Stages of Economic Development*, ILO Working Paper; G. Grossman and A. Krueger (1994), *Economic Growth and the Environment*, National Bureau of Economic Research, U.K.; D. Stern et. al. (1994), *Economic Growth and Environmental Degradation: A Critique of the Environmental Kuznets Curve*, University of York; I. Goldin and A. Winters (1995), *The Economics of Sustainable Development*, Cambridge; G. Grossman and A. Krueger (1995), *Environmental Impacts of a North America Free Trade Agreement*, London; K. Arrow et. al. (1995), "Economic Growth, Carrying Capacity and the Environment", *Science*, Vol. 268, No. 5210; C. Runge (1995), "Trade, Pollution and Environmental Protection", in D. Bromley, *The Handbook of Environmental Economics*, Oxford.

[6]The use of the term subsidies in this Note does not necessarily correspond fully with the definition of the term "subsidy" set forth in the WTO Agreement on Subsidies and Countervailing Measures.

[7]*See*, for example, D. Pearce and D. Moran (1994), "The Economic Value of Biodiversity", *Earthscan*; E. Barbier et. al. (1993), "An Economic Valuation of Wetland Benefits" in G. Hollis et. al., *The Hadejia-Nguru Wetlands: Environment, Economy and Sustainable Development of a Sahelian Floodplain Wetland*, IUCN; B. Halvorsen (1996), "Ordering Effects in Contingent Valuation Surveys: Willingness
(continued…)

environmental quality, various indicators are being developed both at the economy-wide and sector-specific level.[8]

10. Second, environmental benefits may flow from improvements in the institutional, regulatory, monitoring or enforcement capacities of environmental agencies linked to trade policy reform. The political economy of trade protection is such that although trade restrictions and distortions may impose burdens on society as a whole, they are particularly difficult to remove due to the resistance from domestic coalitions and special interest groups.[9] Welfare gains from trade liberalization, including improvements in the environment, exceed costs when viewed in an economy-wide perspective rather than from the perspective of the adversely affected interest group. Institutional reform, permitting trade policy to be viewed in an economy-wide perspective along with the net benefits to society at large - including environmental benefits - would facilitate the task of removing trade restrictions and distortions.

11. Third, the removal of trade restrictions and distortions not only improves the functioning of markets, it also increases the overall security and stability of international trade relations by decreasing uncertainty surrounding markets. It is frequently stated that uncertainty is a major non-tariff barrier to trade. One feature of a more open and liberal trading system is that it expands the opportunities for the sale and dissemination of environmentally-sound goods, services and technologies. In this respect, although no specific trade classification of environmental goods and services exists, recent estimates suggest that annual trade in goods or services related to the environment exceeds US$250 billion per annum, and includes a wide range of equipment, services, and technologies. Examples include energy-efficient machinery, waste water treatment equipment, air pollution scrubbers, and processes to reduce or eliminate chrome in leather tanning. Trade in environmental goods and services continues to grow rapidly in developed and developing economies.[10] Further, it has been shown that as an economy grows and accumulates capital, the rate of technological change quickens and, therefore, possibilities to install environmentally-friendly technology are created.[11]

---

[7](…continued)
to Pay for Reduced Health Damage from Air Pollution", in *Environmental and Resource Economics*, Vol. 8, No. 4; C. Perrings (1995), "Economic Values of Biodiversity" in V. Heywood, ed., *Global Biodiversity Assessment*, UNEP; S. Faucheux et. al., ed. (1996), "Models of Sustainable Development", *New Horizons in Environmental Economics*; and T. Panayotou (1993), *Green Markets: The Economics of Sustainable Development*, HIID.

[8]A. Hammond et. al. (1995), *Environmental Indicators: a systematic approach to measuring and reporting on environmental policy performance in the context of sustainable development*, Washington: World Resources Institute; A. Adriaanse et. al. (1997), *Resource Flows: the materials basis of industrial economies*, Washington: World Resources Institute; M. Munasinghe (1993), *Environmental Economics and Sustainable Development*, World Bank Environment Paper No. 3, Washington. Also *see*, for example, a matrix of environmental indicators which is being developed by UNEP and OECD illustrates the complexity of quantifying environmental benefits. The matrix is organized according to four categories: (i) an environmental index (e.g. poor urban environmental quality, diminishing fish resources, soil degradation); (ii) a pressure index (e.g. air pollution emissions, fish catches, land use changes); (iii) a state index (e.g. concentration of specified air pollutants, sustainable fish stocks, top soil loss); and (iv) a response index (e.g. regulatory and urban transport policies, quotas on fishing, land rehabilitation projects).

[9]*See*, for example, R. Putman (1988), "Diplomacy and Domestic Politics: The logic of two-level games", *International Organizations* Vol. 42; and E. Helpman (1995), *Politics and Trade Policy*, Washington: National Bureau of Economic Research, Working Paper 5309.

[10]OECD (1996), *The Environment Industry*, Paris. Also, a recent report which identifies trade opportunities for developing countries in the environmental goods and services sector notes that case studies "show that the benefits of higher social and environmental performance of exports are many and diverse, including economic gains (such as premium prices and increased sales), social benefits (such as job creation), and environmental improvements, as well as enhanced security through longer-term trading relations". *See* also IIED (1997), *Unlocking Trade Opportunities*, London.

[11]Such change in not directly determined by economic changes *per se*. The choice of technology is usually endogenously determined, with decisions taken at the firm level. *See* N. Stern (1991), "The Determinants of Growth", *Economic Journal* 101; and OECD (1992), *Trade Issues and the Transfer of Clean Technologies*, Paris.

12. The general conclusion that can be drawn from the sectoral analysis that follows is that if adverse production and consumption externalities are adequately integrated into decision-making processes, trade and environmental objectives are mutually supportive. In addition, poverty reduction in developing countries reduces the economic pressure in many regions to exploit environmental resources in an environmentally-unsustainable manner. Accordingly, the focus of this Note is the institutional and economic conditions, domestically and internationally, conducive to "win-win" situations. In short, the sectoral studies point to the positive relationship between the removal of trade restrictions and distortions and improvement of the environment manifests itself through, first, a more efficient factor-use and consumption patterns through trade liberalization and enhanced competition; second, a reduction in poverty through trade expansion and encouragement of a sustainable rate of natural resource exploitation; third, an increase in the availability of environment-related goods and services through market liberalization; and fourth, better conditions for international cooperation through a continuing process of multilateral negotiations.

II. AGRICULTURE

A. Overview

13. The agricultural sector is replete with examples of instances where externalities are not reflected in market prices. The ensuing market imperfections in many instances are considered to have widespread effects on the environment; these include soil degradation, water depletion, deforestation, loss of wildlife habitats and loss of biodiversity.[12] The agricultural sector is also confronted with a large number of measures that distort pricing signals and result in an inefficient allocation of resources. When output prices are held artificially high and input prices held low, the effect is to encourage farmers to increase production, which encourages the extension of production to more vulnerable soils and stream beds, leading to various problems such as soil degradation, sediment damage, increased nutrient loadings in waterways, etc. Conversely, when farm incomes are taxed by artificially lowering food prices to subsidize consumers, and input markets are distorted, deforestation and other land misuses are encouraged.[13]

14. In many developed countries, farmers have been subsidized to ensure food security and maintain income levels. However, it is widely considered that the objective of self-sufficiency has been exceeded and overproduction has taken place in some countries. To address the problem of domestic surpluses, export subsidies have been introduced.[14] In addition, in order to maintain output prices above world market prices, governments have imposed tariffs or other border measures (e.g. variable levies). It has been reasoned that the trade measures that each country adopts are an adjunct of its domestic farm policies. In most cases, a specific measure has been adopted, not for its particular direct benefits, but because it is a device that will make it possible for a domestic policy to function.[15] As far as the nature of trade distortions and restrictions are concerned, price supports, trade barriers, quantitative

---

[12]For instance, the contamination of groundwater aquifers which frequently takes place as a result of the leakage of farm chemicals, is a process which occurs over large numbers of years. The environmental damage can occur far from the site in which the harmful activity takes place (in this instance, where actual chemicals are employed), and the polluters can be difficult to identify. *See* F. Runge (1994), "The Environmental Effects of Trade in the Agricultural Sector" in OECD *The Environmental Effects of Trade*, Paris: OECD.

[13]*See* F. Runge (1994), "The Environmental Effects of Trade in the Agricultural Sector" in OECD, *The Environmental Effects of Trade*, Paris: OECD.

[14]*See* J. Lankoski (1997), *Environmental Effects of Agricultural Trade Liberalization and Domestic Agricultural Policy Reforms*, (UNCTAD/OSG/DP/126), Geneva: UNCTAD Discussion Paper.

[15]*See* D. Johnson (1991), *World Agriculture in Disarray*, London: Macmillan.

restrictions on output, subsidies to inputs and direct budgetary payments, are all common in this sector. Such measures affect the decisions that are taken regarding the types of crops to grow and their quantities. These decisions often have significant environmental effects.

15. A process of agricultural reform has began in some countries.[16] The objective has been to move towards policies that are less production and trade distorting, and which increase the compatibility between agricultural activities and the environment, by progressively reducing agricultural support and delinking support from production or to factors of production. Quantitative restrictions on output can also play a part in reform when they are used to restrict the amount of production receiving support. Other criteria, such as social and environmental concerns, may be important considerations in reforming the agricultural sector.[17]

16. As can be seen from the Appendix Table, world trade in agricultural products in 1996 was US$586 billion. On a regional basis, the largest trader was Western Europe with total exports of US$246 billion, of which US$186 billion was traded within the region. Total agricultural imports into Western Europe were US$260 billion. Exports from North America were US$114 billion and imports US$28 billion with the largest export market being Asia (US$44 billion). The largest market for Latin American exports of agricultural products (total exports of US$62 billion) was Western Europe (US$20 billion) followed by North America (US$16 billion). Asian exports of US$ 112 billion were dominated by intra-Asian trade (US$71 billion).

17. Aggregate trade flows for both products and regions mask very different experiences for individual countries and products. Similarly, individual countries have had many different experiences with respect to the production of different agricultural products. The following provides more detailed data regarding agricultural product categories.

18. For livestock production, in 1996 approximately 30 per cent of total world meat production took place in China, followed by the United States (16 per cent), and the European Communities (15 per cent). In the same year, the largest exporters were the United States (28 per cent), Western European countries (19 per cent), and Australia (9 per cent). Major milk and dairy producers were the western European countries with 37 per cent of total world production, followed by the United States (16 per cent) and India (14 per cent). The three largest exporters in the sector were the European Communities (36 per cent), New Zealand (25 per cent), and Australia (13 per cent).[18]

19. For cereals, the major producers in 1996 were China, the European Communities, and the United States; they accounted, respectively, for 21 per cent, 19 per cent and 17 per cent of the global cereal output. North America and Europe were the largest exporters of cereals. World fruits and vegetables production concentrated mainly in the European Communities (33 per cent), China (47 per cent) and India (21 per cent). The biggest exporter was Western Europe.[19]

---

[16]For example, in 1987 at the OECD Council of Ministers, at the meeting of Agriculture Ministers in 1992 and the High Level Meeting of the Committee for Agriculture in 1994, the reform measures were further developed.

[17]It is important to note that agricultural policy reform in a number of OECD countries has been accompanied by environmental measures, such as agri-environmental regulation and sustainable forestry management schemes. The agri-environmental regulation (Council Regulation 2078/92) requires EU Member states to develop programmes to promote agricultural production methods compatible with environmental protection and with the maintenance of the countryside. *See* OECD (1997), *The Environmental Effects of Reforming Agricultural Policies, A Preliminary Report,* Directorate for Food, Agriculture and Fisheries and Environment Directorate, Paris.

[18]FAO (1997), *Rapport sur les Marchés des Produits 1996-97*, Rome.

[19]*See* FAOSTAT (1997), *Agriculture Statistics Database,* Rome.

20. The production of beverages is important for developing countries. The major coffee producers in 1996 were Brazil, Colombia and Indonesia, which accounted respectively 21 per cent, 14 per cent and 7 per cent of the world coffee production and 34 per cent of the total world coffee exports in 1996 collectively. In the same year, Côte d'Ivoire, Ghana, and Indonesia were the most important cocoa producers and exporters with respectively 38 per cent, 12 per cent and 13 per cent of total world cocoa output , and, as a whole, 79 per cent of total exports. In 1996, the European Communities (14 per cent), India (13 per cent), and Brazil (12 per cent) were the largest sugar producers with a total share in world sugar production of 38.5 per cent. The main sugar exporters were the European Communities, Brazil and Australia with respectively 23 per cent, 18 per cent and 4 per cent of total world sugar exports.[20]

21. Tea production was mainly in India (29 per cent), China (23 per cent) and Kenya (10 per cent). Overall, these countries accounted for the 62 per cent of total world tea production. Tea exports originated mainly from Sri Lanka (22 per cent), Kenya (21 per cent) and China (16 per cent).

22. In 1996, for world primary fibre crops production, India, China and the Unite States ranked as the top producers with respectively 20 per cent, 19 per cent and 16 per cent of total world output. In the same year, the United States (15 per cent), Malaysia (11 per cent), and India (10 per cent) were the major producers of primary oil crops.[21]

B. Trade Restrictions and Distortions

23. The Uruguay Round Agreement on Agriculture disciplines government support to the agricultural sector. Under the WTO, agriculture is subject to a tariffs-only regime which is backed by a prohibition on the use of border measures other than ordinary customs duties as specified in Article 4:2 of the Agreement on Agriculture.[22] Both the tariffs resulting from the Uruguay Round tariffication process, which represent about twenty per cent of all agricultural tariff lines, as well as pre-existing agricultural tariffs have been bound and are subject to reduction and other commitments as specified in Members' schedules. In the case of tariffied products, these commitments generally include minimum and/or current access tariff quotas, as well as the right to have recourse to the special safeguard provisions of Article 5 of the Agreement on Agriculture. For developed country Members, tariffs are being reduced over six years by an unweighed average of 36 per cent, subject to a minimum reduction of 15 per cent for each tariff line. For developing country Members, the corresponding reductions, where applicable, are 24 per cent over 10 years with a minimum reduction of 10 per cent. Least-developed country Members were not required to undertake reduction commitments.

24. Under the Agreement on Agriculture, there is a prohibition on the use of export subsidies on any agricultural product which is not specified in a Member's schedule as being subject to a reduction commitment. Domestic agriculture subsidisation or support measures which are not maintained in conformity with the various exemption criteria provided for in the Agreement on Agriculture are either subject to reduction commitments as specified in country schedules or to general rule-based de minimis commitments. There are three exemption categories: (i) domestic support measures which are non or minimally trade distorting (the "Green Box"); (ii) direct payments under production-limiting programmes (the "Blue Box"); and (iii) certain governmental assistance measures, whether direct or indirect, to encourage agricultural and rural development as an integral element of development programmes of developing countries (the "S&D Box"). The Green Box contains two specific provisions for exceptions in respect of environmental measures. The first is under the category of general

[20]FAO (1997), *Rapport sur les Marchés des Produits 1996-97*, Rome.

[21]FAOSTAT (1997), *Agriculture Statistics Database*, Rome.

[22]There are a limited number of product-specific exceptions (mainly on rice) to this prohibition.

government services provided to agriculture or the rural community and relates to "research in connection with environmental programmes." The second is under the category of direct payments to producers under environmental programmes.

25. In 1995, almost two-thirds of total assistance in developed countries took the form of commodity-based market price support. Such support maintains higher market prices for certain commodities, encouraging their production relative to other non-subsidized commodities. Market price support has often been accompanied by other policy measures, such as supply controls and land use restrictions, to decrease the total quantities produced of the subsidized commodities. In addition, it has been frequently accompanied by import tariffs on similar commodities to enable higher domestic prices to be maintained, as well as by export subsidies to prevent the build up of surpluses.

26. Direct income payments to farmers are increasing, and are the second most prevalent form of assistance in developed countries. Comparing the 1986-88 period with 1996, price support as a share of total assistance to agriculture in industrial countries decreased from 79 to 60 per cent, while the share of direct payments increased from 18 to 23 per cent.[23] While direct payments may also influence the allocation of resources, they are seen to distort production decisions less than market price support and are more transparent.

27. In developed countries, subsidies to inputs in agriculture take the following forms: (a) subsidies to capital (interest-free loans or loans at concessional rates); (b) investment grants; (c) subsidies to irrigation water, fertilizers and pesticides; and (d) government financed services, such as livestock insemination. In virtually all developed countries, governments finance a number of general services in the agricultural sector. These services include research, extension, training, inspection, and market promotion of agricultural products.

28. To take cereal and dairy, for example, in developed countries four major policy instruments are used to support cereal and dairy producers: (a) market price support; (b) deficiency payments; (c) production quotas; and (d) direct income support. While market price support fixes the domestic market price at a level higher than the equivalent world market price, deficiency payments guarantee producers a per unit payment for output equal to the difference between the market price and an administrative target price. Using production quotas, governments set a support price while restricting production to a level below that which would otherwise occur with the support price. The objective is to prevent the build up of surpluses. Direct income support is the payment made by government directly to farmers, which occurs independently of the level of current and future production.[24]

29. Agriculture is a sector in which technical regulations, and packaging and labelling requirements are applied extensively in order to achieve various policy objectives. Because the sector impacts on human, animal and plant life and health, various technical regulations and requirements are designed to minimize potential negative impacts in the domestic market. Several notifications to the Agreement on Agriculture list support to encourage the conservation of agricultural lands, to prevent soil erosion, soil acidification, and to encourage the use of organic fertilizers, and reference is also made in several notifications to specific assistance available concerning wheat, feed, grains, rice and upland cotton programs provided they are in compliance with conservation requirements. A notification to the Agreement on Subsidies and Countervailing Measures lists agricultural support policies for sheep and milk production in which one objective included "integrating environmental issues with agricultural

[23]OECD (1997), *The Environmental Effects of Reforming Agricultural Policies, A Preliminary Report*, Directorate for Food, Agriculture and Fisheries and Environment Directorate, Paris.

[24]*See* J. Lankoski (1997), *Environmental Effects of Agricultural Trade Liberalization and Domestic Agricultural Policy Reforms*, (UNCTAD/OSG/DP/126), Geneva: UNCTAD Discussion Paper.

policy". Another one links support of privatization, restructuring and research in agriculture to support of "genetic potential," preservation of the country-side and protection of water.

30. Under the Agreement on Sanitary and Phytosanitary Measures (SPS), a total of 365 agriculture-related notifications were received over the period 1995-97. These include notifications made by Ministries of Agriculture, as well as those that address agricultural products and inputs to agriculture. In SPS notifications, a wide range of product categories are addressed, and include, biological control agents, inorganic contaminants of agricultural products, inputs for livestock use, and food additives. The notifications frequently set product standards, and/or mandate labelling and packaging requirements. The objective of the measures notified is usually the protection of human, animal, plant life or health.

C. Environmental Benefits

31. Several proposals have been made in the CTE regarding the environmental benefits of removing trade restrictions and distortions in the agricultural sector. Reference is made to these proposals in the 1996 Report of the CTE.[25]

32. The agricultural sector is important from an environmental perspective because of its direct reliance on land and water resources used for agricultural production, and the effects of agricultural production on these resources as well as air quality and biodiversity. While a large body of literature exists on the effects of agricultural production on the environment, there is little information on the environmental effects of trade liberalisation in the agricultural sector. Most studies model the impact of trade liberalization on production, and then infer likely side-effects on the environment.[26] This section highlights key findings of some of these studies.

33. Anderson and Tyers have constructed a model of world food markets, which has been used by a number of researchers as a basis from which to infer the likely environmental impacts of production changes.[27] In one scenario, the production effects of removing all agricultural support in industrialized countries in 1990 was estimated, with full adjustment occurring the same year. The model predicts that world prices of agricultural products will rise on average, while estimated effects on world food output is negligible. With changes in relative prices and world prices, a small relocation of agricultural production takes place. For example, a contraction of 5 to 6 per cent in grain and meat production takes place in developed countries and 3 to 8 per cent higher in developing countries. The most significant declines in production are experienced in Japan and Western Europe, which are partly offset by increases in North America and Australasia. While a quarter of the total increase takes place in the latter two regions, developing countries provide the balance.[28] In a different simulation (also using the same model), trade is liberalized in both developed and developing countries and a greater relocation of production takes place. The decline in output in some industrialized countries is matched by an

[25]Reference to the following submissions on Item 6 which address agriculture is contained in pages 23 to 28 of the 1996 Report of the CTE (WT/CTE/1): Trade Liberalization, The Environment and Sustainable Development; Submission by Australia (WT/CTE/W/36); Communication from Argentina on Item 6 of the Committee's Work Programme (WT/CTE/W/26); Trade Liberalization and the Environment, A Contribution by the United States (WT/CTE/W/35); Non-Paper by the European Union on Item 6 (23 July 1996); Non-Paper by India on Item 6 (20 June 1996); Non-Paper by Japan on Item 6 (24 June 1996); and, Non-Paper by the Republic of Korea on Item 6 (24 July 1996).

[26]Different models tend to look at different liberalizing areas and commodities and are based on different assumptions relating to, for example, import and export demand and supply elasticities.

[27]*See* K. Anderson and R. Tyers (1992), *Disarray in World Food Markets: A Quantitative Assessment*, Cambridge: Cambridge University Press.

[28]*See* K. Anderson and A. Strutt (1994), *On Measuring the Environmental Impacts of Agricultural Trade Liberalization*, Seminar Paper 94-06, Centre for International Economic Studies, Adelaide: University of Adelaide.

increase in output in others. As a result, the total quantity of world food output does not change, and in the long-run, international prices stay the same on average.[29]

34. Under this scenario, it is argued that numerous environmental benefits would ensue from trade liberalization. The model suggests that declining agricultural production in densely populated countries with relatively high levels of protection will reduce environmental degradation by more than a comparable increase in environmental degradation in regions with expanding production. For example, the increased use of agro-chemicals in expanding areas would begin from a low base, and is assumed to reach modest levels compared to intensive use in densely populated areas prior to production contraction.[30] Meat production would also be expected to shift from densely populated countries, to the more sparsely populated ones. The model assumes that decreases will occur in the extent to which the livestock is fed grain and supplements rather than fed by grazing on pastures. It is reasoned that risks of disease associated with range or pasture feeding are smaller compared to risks associated with the production of livestock in enclosed conditions, so that the use of veterinary medicines and growth hormones would shrink, together with health risks linked to chemical residues in food. The model suggests that use of less intensive livestock production methods (associated with range feeding) will result in less air, soil and water contamination from the disposal of animal effluent, and insofar as relocation leads to greater use of crop/leguminous pasture rotation methods, there will be a decline in the chemical fertilizers used and, therefore, a decline in water pollution from nitrates and other agro-chemical run-off problems (e.g. build-up of heavy metals or other toxic substances, destruction of fish habitats, accumulation of silt, and increase in plant and algal growth). In areas of contracting agricultural production, as price supports are reduced, output prices and land values are expected to fall, and the absolute amount of farm chemicals, irrigation water, feed concentrates and other agricultural inputs associated with environmental degradation will decrease as agriculture becomes less profitable.[31]

35. This argument has been supported by studies which find that chemical fertilizer applications are strongly correlated with producer price incentives. It was found in the mid-1980s, that countries with relatively low producer prices used less than one-twentieth the amount of chemical fertilizer per hectare when compared to high-priced countries.[32] With a fall in the price of agricultural products in contracting regions, therefore, the use of chemical fertilizers is likely to decline. It has been argued that in these regions, land might revert to recreational and other non-farm uses, with possible positive environmental effects.[33]

---

[29]It is important to note, however, that under both simulations, developed countries face lower domestic prices for agricultural products (as a result of reducing domestic price support), and developing countries face higher domestic prices (at least in the short-run, when international prices rise and stimulate production). *See* K. Anderson (1992), "Agricultural Trade Liberalization and the Environment: A Global Perspective", *World Economy*, Vol. 15, No. 1.

[30]Note that it is often counterargued that price adjustments flowing from trade liberalization will not necessarily lead to less intensive agriculture. This counterargument rests on the notion that factors other than trade liberalization, such growth in world demand for food, also influence the development of agricultural markets. World demand for food will increase with demographic growth, particularly in developing countries, and this may intensify agricultural production.

[31]K. Anderson and A. Strutt (1994), *On Measuring the Environmental Impacts of Agricultural Trade Liberalization*, Seminar Paper 94-06, Centre for International Economic Studies, Adelaide: University of Adelaide.

[32]In addition, an econometric study conducted on 11 Asian countries (in which the domestic price of agricultural products has been relatively high) has found that the elasticity of demand for chemical fertilizer with respect to the relative price of rice to fertilizer was between 0.4 and 0.7 in the short-run and higher still in the long-run. *See* K. Anderson and R. Blackhurst (1992), *The Greening of World Trade Issues*, New York: Harvester Wheatsheaf.

[33]K. Anderson and A. Strutt (1994), *On Measuring the Environmental Impacts of Agricultural Trade Liberalization*, Seminar Paper 94-06, Centre for International Economic Studies, Adelaide: University of Adelaide.

36. The argument that environmental benefits would ensue to areas of contracting agricultural production is also corroborated by studies which demonstrate that subsidies and price support have sent the wrong price signals to farmers; farmers, when faced with a choice of growing a highly subsidized crop, as opposed to a greater annual rotation with less subsidy, do what is rational and grow the subsidized crops year after year[34], until land either becomes less productive or subsidies decline.[35] Distortions at the farm level, affect farmers' decisions with respect to what crops to plant, how often to plant them in relation to other crops, and how much water, fertilizer and pesticides to apply. They have provided farmers with a disincentive to rotate crops (focusing only on the subsidized ones), and to over apply fertilizers and pesticides.

37. It has also been suggested[36] that income growth effects of trade liberalization can be beneficial for the environment. First, the rate of population growth generally has been found to decline as income rises, and this could reduce an important source of pressure on both urban and rural environments. Second, demand for pollution abatement policies is income elastic (at least beyond a certain threshold), and the cost of compliance falls as rising incomes and more open borders allow for the adoption of more environmentally-sound production technology, consumer products and inputs.

38. Other studies arrive at similar conclusions by analysing the extent to which changes in production induce changes in the demand for factors of production.[37] In the short-run the strongest adjustment takes place in variable inputs such as fertilizers and pesticides. Although the impact on production is difficult to forecast, in industrialized countries, there is a decline in the use of these inputs with benefits to the environment, such as the reduction in nitrate and pesticide levels in groundwater.

39. In response to the decline in the price of agricultural output, other, less variable inputs, such as land, would also adjust although at a slower rate. In industrialized countries, land under cultivation is likely to decline and a gradual "idling" of marginal lands can be expected to take place. This is expected to reduce soil erosion in marginal lands, as weeds and shrubs begin to stabilize the soil. In addition, an idling of marginal lands would permit some biodiversity to return or recover. At the same time, while some of the ecological properties of land would be restored, irreversible damage previously done to the environment would not be reversed. For instance, little could be done to restore the wetlands that have been drained and cultivated and the species that have become extinct. Different initiatives are under way at the national level to determine how long idling lands should remain unused, and to what extent set-aside land programmes can be adjusted to accommodate, for example, various environmental land-use proposals.

40. Although a number of environmental benefits are likely to ensue to developed countries as a result of liberalization, other, more ambiguous, environmental impacts are also likely to arise from removing land from agriculture. For example, afforestation of abandoned land may result in positive environmental effects in some areas, whereas in others the impact may be negative, particularly where it involves the planting of non-indigenous species or monospecies. Moreover, it is possible that fluctuating prices would result in increased shifting among crops. While this would reduce specialization and increase diversification (which is positive for the environment) shifting into and out of crops could

---

[34]F. Runge (1994), "The Environmental Effects of Trade in the Agricultural Sector", in OECD, *The Environmental Effects of Trade*, Paris: OECD.

[35]As in the fisheries sector, declines in productivity may result in an increase in subsidy support, agro-chemical inputs or other input support, thereby creating a circle of lowering yields, and higher rates of protection.

[36]K. Anderson and A. Strutt (1994), *On Measuring the Environmental Impacts of Agricultural Trade Liberalization*, Seminar Paper 94-06, Centre for International Economic Studies, Adelaide: University of Adelaide.

[37]E. Lutz (1992), "Agricultural Trade Liberalization, Price Changes and Environment Effects", *Environmental and Resource Economics*, Vol. 2.

result in accelerated soil erosion. In addition, the abandonment of lands could reduce land values, decrease green buffer zones, and lead to a decline in the scenic beauty of landscape.[38] In this respect, it has been noted that a distinction should be made between land abandonment and land which lies fallow during crop rotation agricultural methods.

41. Studies in this area suffer from a number of weaknesses. First, they do not distinguish between different groups of developing countries. In sub-Saharan Africa and other parts of the world where the green revolution has not taken place to the same extent as in other regions, chemicals are only minimally employed in agricultural production.[39] Based on the studies that argue that in sub-Saharan Africa higher farm output prices are unlikely to cause a significant increase in the use of chemical inputs, some studies show that increases in their application are unlikely to cause significant environmental harm. It is suggested that because of intensive land-use methods and soil nutrient balance in some countries could actually be restored with the increased application of fertilizers.[40] However, this has not been empirically determined and considerable caution is needed when speculating on a return to ecosystem balance based on an optimal agro-chemical input level.

42. Another result of liberalisation is that higher international prices for agricultural products in developing countries could lead to a shift from food crops to exports crops. Such a shift could have uncertain environmental consequences, which would depend on the type of crops in question. Commercial crops (and export crops) are frequently grown in monoculture. Monoculture can have negative effects on the soil: for example, pesticides used to combat insects or plagues that are often used in monoculture also kill organisms that help maintain organic soil structures. Moreover, monoculture can result in a low vegetation cover, which can lead to soil erosion. The effects of agricultural specialization, ecosystem conversion and biodiversity loss is an important factor in determining environmental effects, and more empirical data is needed in this regard. It is possible that the increased export production of certain crops could accelerate soil nutrient depletion and disrupt the natural cycle of soil replenishment. In some countries, soil erosion is already relatively high for certain crops such as cotton and soybeans, and relatively low for others, such as wheat and rice. The extent to which a shift in production takes place is a factor which must be given adequate consideration in examining the impact of liberalization on the environment.[41]

43. Transport-related environmental externalities, due to changes in freight traffic costs are an important dimension of liberalization in agricultural trade and its environmental impact. While there is little doubt that freight traffic will increase as a result of trade expansion, the magnitude of the increase will depend on shifts in the patterns of trade, the volume of trade and the distances covered. The composition of agricultural trade and shifts towards higher-value added agricultural commodities could also influence freight traffic. However, it has been found that changes in freight traffic associated

---

[38]Note that numerous positive environmental externalities are said to be associated with agriculture, such as: the value of agriculture in preventing soil erosion and floods, adjusting micro-climates, preserving bio-diversity, providing recreational space, and so on. Other positive externalities which are not necessarily environmental, include maintaining local cultures and communities.

[39]It has been estimated that world fertilizer use in 1996 increased to 128 million tonnes, an increase of 5 per cent from 1995. Much of the increase has taken place in developing countries: for example, China used an estimated 32 million tonnes of fertilizers in 1995; marginal increases were reported in India, Pakistan and Bangladesh, which together reported a 4 percent increase to 17.8 million tonnes; in Africa, which uses only 2.5 million tonnes for the entire continent, fertilizer use remains unchanged; while in Latin America aggregate use declined marginally, despite significant increases in Argentina in 1995. *See* K. Soh and K. Isherwood (1997), "The Agricultural Situation and Fertilizer Demand" cited in *Vital Signs*, Washington: Worldwatch Institute.

[40]*See* Heerink et. al. (1996), "Policy Issues in International Trade and the Environment with Special Reference to Agriculture", in M. Munasinghe, ed., *Environmental Impacts of Macroeconomic and Sectoral Policies*, Washington: World Bank.

[41]Ibid.

with trade liberalization are likely to be small in relation to the changes that will result from economic growth more generally.[42] With greater trade flows and more open borders, ensuing environmental costs could include increased air pollution, greater risk of the introduction of alien species, increased risk of pests and animal diseases being transferred between countries may arise. Some of these issues are not new problems for international trade, and have been addressed through sanitary and phytosanitary measures. Bulky, unprocessed agricultural products are usually transported using relatively energy intensive forms of transportation. In addition, the perishable nature of many agricultural products requires that fast, energy intensive transport be employed. Increased transportation due to trade liberalization could magnify existing negative environmental externalities.[43]

44. The relationship between price changes and soil degradation in developing countries is the subject of a number of contradictory views. One view is that higher prices will affect soil conservation positively. As the profitability of agricultural production increases, the value of farmland will rise. As a result, farmers will have a greater incentive to develop and conserve their farmland.[44] Another view is that higher prices may have negative effects on soil conservation, whereby better farm prices could encourage the over-exploitation of land resources leading to accelerated soil erosion and nutrient depletion.[45] The neutral view is that price changes will not have much of an effect on conservation.[46]

45. In order to analyze carefully the effect of price changes on soil conservation, four inter-related elements have been noted as relevant. They include: (a) current versus future production decisions; (b) farm practices; (c) productivity versus conservation investments; and (d) farmers' private discount rates.[47] In making production decisions, farmers are confronted with two choices: either cultivate more land today and gain immediately at the expense of the soil and of reduced future returns, or produce less today and benefit more in the future at the expense of short-term output. The decision that farmers make is affected by a number of variables, such as input and output prices, their private discount rates, and land tenure arrangements. Alternatively, certain farm practices could prevent agricultural production techniques from degrading the soil. The effects of liberalization and price rises on soil conservation would in this respect, therefore, need careful empirical analysis.

46. With respect to productivity versus conservation investments, it has been argued that higher incomes that result from rising prices allow farmers to undertake both productivity investments (such as in irrigation), and investments in conservation (such as in terraces and windbreaks). Rising output prices raise the price of land, and the returns to farmers in the development and conservation of farmland. Secure property rights are necessary to ensure that farmers will have an incentive to make long-term investments in sustainable land use.[48]

---

[42]*See* OECD (1997), *The Environmental Effects of Reforming Agricultural Policies, A Preliminary Report*, Directorate for Food, Agriculture and Fisheries and Environment Directorate, Paris.

[43]*See* Heerink et. al. (1996), "Policy Issues in International Trade and the Environment with Special Reference to Agriculture", in M. Munasinghe, ed., *Environmental Impacts of Macroeconomic and Sectoral Policies*, Washington: World Bank.

[44]R. Repetto (1989), "Economic Incentives for Sustainable Production", in G. Schramm and J. Warford, eds., *Environmental Management and Economic Development*, Baltimore: Johns Hopkins University Press.

[45]M. Lipton (1987), "Limits of Price Policy for Agriculture: Which Way for the World Bank?" *Policy Development Review 5*.

[46]S. Barrett (1991), "Optimal Soil Conservation and the Reform of Agricultural Pricing Policies", *Journal of Development Economics 36*.

[47]*See* Heerink et. al. (1996), "Policy Issues in International Trade and the Environment with Special Reference to Agriculture", in M. Munasinghe, ed., *Environmental Impacts of Macroeconomic and Sectoral Policies*, Washington: World Bank.

[48]Ibid.

47. In producing different scenarios of the environmental impacts of liberalization, input substitution and technological innovation may also affect the response of agricultural systems to changes in production. Such innovations might enable agricultural systems to adapt to expansions or contractions of agricultural activity, with minimal damage to the environment. One study suggests that shifts in production are unlikely to either improve or degrade the environment in the long-run. This is considered to be the case as only modest shifts in production are expected as a result of agricultural trade liberalization.[49] At this stage, a sufficient body of empirical evidence has yet to be accumulated.

48. Finally, various transboundary or global environmental problems are associated with agricultural production, and include global warming, ozone depletion, and the loss of biological diversity. For example, agricultural activity has been linked to the release of several greenhouse gases[50] and ozone depleting substances.[51] However, agricultural activity can act as an important carbon sink, and can contribute to maintaining biodiversity habitats. Work is under way in various fora to assess these global environmental issues, including in the Intergovernmental Panel on Climate Change, the Framework Convention on Climate Change, Scientific and Technical Committees of the Montreal Protocol, and the Framework Convention on Biodiversity.

III. ENERGY

A. Overview

49. Between 1986 and 1995, total world output of primary energy - petroleum, natural gas, coal and electric power (hydro, nuclear, geothermal, photovoltaic and wind-powered), increased by an annual rate of 1.6 per cent. In 1995, total world production was estimated at 361 exajoules.[52]

50. Petroleum continues to be the world's primary energy source. In 1995, it accounted for approximately 40 per cent of total production, or 142 quadrillion Btu. Between 1986 and 1995,

---

[49] *See* OECD (1997), *The Environmental Effects of Reforming Agricultural Policies, A Preliminary Report,* Directorate for Food, Agriculture and Fisheries and Environment Directorate, Paris.

[50] The main greenhouse gases emitted by the agricultural sector are the following: carbon dioxide, methane, and nitrous oxide. Agriculture is the greatest emitter of methane and nitrous oxide globally, and contributes 50 and 70 per cent of world totals (it is the most significant anthropogenic source of these two gases). After fuel combustion, agriculture is the most significant emitter of carbon dioxide. This includes the carbon dioxide emissions that result from deforestation. With respect to carbon dioxide, agriculture is both a source and a sink of this gas. The agricultural sector contributes to carbon dioxide emissions mainly through the combustion of fuels for field cultivation. The clearing of forests and the conversion of prairies to cropland also contribute to total carbon dioxide emissions. In addition, a number of other agriculture-related activities contribute to carbon emissions. For instance, the manufacture of inorganic fertilizers is energy intensive and releases significant amounts of carbon dioxide. However, agriculture also provides storage for carbon dioxide. Grazing results in the fixation of carbon in soils, and afforestation provides a sink for carbon. Nitrous oxide is primarily released from nitrogen fertilizer. The main source of methane in agriculture is livestock. This gas is produced as part of the digestive process of ruminant animals and from the anaerobic decay of livestock waste. Rice paddies also generate methane as a result of the anaerobic decomposition of organic materials in flooded fields. Emissions per kilogram of harvested rice in different countries vary depending on water management and cultivation practices.

[51] The main ozone depleting substance released by agriculture is methyl bromide. It is a fumigant that is used for pest control in soils, and in the storage of commodities. In international trade, methyl bromide is frequently used to ensure that pests do not travel across borders along with agricultural emissions of methane form ruminant livestock have declined with stock numbers. *See* Wellington (1997), "New Zealand: The Environmental Effects of Removing Agricultural Subsidies", in the OECD's *Helsinki Seminar on Environmental Benefits from Agriculture; Country Case Studies*, Paris: OECD.

[52] One exajoule is the equivalent of approximately 163 million barrels of oil.

petroleum production increased by 7.5 million barrels per day, or 12.5 per cent over the period. World demand for oil was estimated at 70 million barrels per day in 1995.[53]

51. Coal is ranked as the second primary source of energy, accounting for approximately 25.3 per cent of world primary energy production in 1995. World coal production totalled 5.1 billion short tonnes - or 91 quadrillion Btu - in 1995, representing an increase of approximately 1.4 per cent since 1986. Coal production experienced the lowest annual rate of production growth of any primary energy source between 1986 and 1995, increasing by less than 0.2 per cent over that period.[54] With coal, solid fuels are estimated to account for 27 per cent of total commercial energy production. Other examples of solid fuels are lignite, peat and wood. However, unlike petroleum sources, solid fuels are generally consumed in the country in which they are extracted due to high costs of transportation.[55]

52. Natural gas is ranked the third most prevalent primary energy source, in 1995 accounting for approximately 21.4 per cent of world primary energy production. Production of natural gas was 78.3 trillion cubic feet, or 77 quadrillion Btu in 1995, representing an increase from 1986 of over 23 per cent, and an increase of approximately 70 per cent in the last two decades. Estimates suggest that natural gas continues to undergo the steepest increase in production compared to other primary energy sources, and in 1996 natural gas production increased by 4.5 per cent.[56] The largest reserves of natural gas are located in Russia which accounts for approximately 50,000 billion cubic meters of gas reserves, or roughly one-third of total world reserves. Natural gas is widely regarded as being a preferred source of energy from an environmental perspective for which worldwide demand is expected to increase.

53. Primary electricity accounts for approximately 10 per cent of total world energy consumption. Hydro-electric, nuclear and other sources (i.e. geothermal, solar and wind power) of power generation were ranked fourth, fifth and sixth respectively as primary energy sources in 1995, accounting for 7.1, 6.5 and 0.4 per cent respectively of world primary energy production.[57] Hydro-electric power represents the largest share of primary electric power generation, contributing 2.5 trillion kilowatt hours in 1995, representing an increase of 22.8 per cent since 1986. Between 1986 and 1995, nuclear power production increased by approximately 45 per cent, generating 2.2 trillion kilowatt hours in 1995. Between 1995 and 1996, nuclear power generation increased marginally, by less than 1 per cent. Renewable sources of energy supply - geothermal, solar and wind power generation - have increased significantly since 1986, rising to 111 billion kilowatt hours, or a 225 per cent increase. Renewable energy sources produce energy by converting natural phenomena (heat of the earth's core, solar and wind power) into usable energy forms.[58] Despite their small share of total world energy production, solar and wind energy production have experienced relatively large increases in recent years for various reasons (e.g. lower cost per kilowatt hour, increased emphasis in some countries on improved demand-side management, greater reliance on renewable energy sources, and increased environmental awareness).

---

[53]International Energy Agency (1996), *World Energy Outlook*, Paris: IEA.

[54]US Department Of Energy (DOE) (1996), *International Energy Annual 1995*, Washington.

[55]World Energy Council (WEC) and the International Institute for Advanced Systems Analysis (1995), *Global Energy Perspectives to 2050 and Beyond*, London: WEC.

[56]US DOE (1996), *Monthly Energy Review*, Energy Information Administration, Annual Energy Review, Washington.

[57]US DOE (1996), *International Energy Annual*, Energy Information Administration, Washington.

[58]World Resources Institute (1997), *World Resources 1996-1997*, Oxford: Oxford University Press.

54. The world's five leading producers of primary electricity in 1995, representing over 50 per cent of total energy production, were the United States, Russia, the People's Republic of China, Saudi Arabia and Canada. The next five leading producers for the same year were the United Kingdom, Iran, Norway, India and Venezuela.[59] The five largest consumers of primary energy in 1995 were the United States, China, Russia, Japan and Germany, followed by Canada, India, the United Kingdom, France and Italy, which have a combined energy consumption of almost 65 per cent of total primary energy supplies.

55. Energy consumption in countries with economies in transition have increased significantly since 1973, despite a decline in consumption from 1989 to 1992: for example in the former Soviet Union and in Central European countries energy consumption decreased by 17 per cent during that period. Energy consumption in developing countries has continued to increase in recent years, although for many countries this increase should be measured against a relatively small base. Although total energy consumption has undergone a three-fold increase since 1973, developing countries as a whole account for approximately one-third of total energy consumption. Within developing countries, the countries of the Asia Pacific region consume approximately 60 per cent of total world energy demand among all developing countries, accounting for the bulk of demand increase in recent years. Latin America has doubled its energy consumption since 1973, and Africa has tripled its energy consumption. Despite these increases, Africa accounts for 11 per cent of total energy use of all developing countries, and even less when viewed in terms of percentage of world consumption.[60]

56. According to the International Energy Agency, three major trends in world energy demand can be identified: (a) world primary energy demand is expected to continue the sustained growth it has undergone for the last two decades to the year 2010; (b) fossil fuels are expected to account for 90 per cent of world energy demand until the year 2010; and (c) a structural shift in energy consumption is likely to occur, whereby the total share of energy consumption by developed countries is expected to decline from approximately 55 per cent in 1995 to less than 50 per cent by 2010, while the total share of developing country consumption is expected to increase from the current level of approximately 28 per cent to approximately 40 per cent by 2010.[61]

B. Trade Restrictions and Distortions

57. Unlike other sectors addressed in this Note, production in the energy sector is not an end in itself; energy is an important input to almost all economic activities. Reforming energy policies will impact on virtually all aspects of economic activity. Estimating the effect of changes in energy prices on different economic activities is difficult, as energy input requirements vary are across and within sectors, and between countries.

(a) Subsidies

58. Several types of subsidies are applied both directly and indirectly to energy production. As in other sectors, different subsidies have varying economic and environmental effects. Given the linkage between the energy sector and virtually all forms of economic activity, identifying the existence and nature of subsidies (e.g. whether direct, indirect or implicit) is complex.

---

[59]US DOE (1996), *International Energy Annual*, Washington.

[60]World Energy Council and the International Institute for Advanced Systems Analysis (1995), *Global Energy Perspectives to 2051 and Beyond*, London. *See* also OECD (1996), *Energy Statistics of OECD 1994-1995*, Paris; Worldwatch (1997), *Vital Signs 1997-1998*, Washington; World Resources Institute (1996), *World Resources 1996-1997*, Oxford: Oxford University Press.

[61]International Energy Agency (IEA) (1996), *World Energy Outlook*, Paris: IEA.

59. Examples of energy subsidies include: (a) direct subsidies; (b) tax concessions or tax exemptions; (c) low-cost long-term land concessions for energy exploration or production activity; (d) government absorption of different risks associated with exploration or production (such as liability waivers); (e) energy-infrastructure subsidies (such as low-cost power transmission lines, low-cost land concession rights, and petroleum import or export facilities); (f) the provision of free accident insurance; (g) the provision of loan guarantees; (h) grants or tax incentives to develop energy-related technologies; (i) transfers to upgrade either commercial or household energy sources; (j) grants or tax incentives to lower operating costs in various energy-intensive commercial production activities; and (k) transfers to lower household heating bills.

60. In certain instances, subsidies can also be used to provide incentives for the development and use of renewable energy or more environmentally-friendly technology. As set out in WT/CTE/W/46, several WTO notifications in 1996 provided information related to enhancing energy-efficiency, promoting energy conservation and/or savings or setting out product or performance-based regulations for a broad range of products, including electrical appliances, heaters and boilers, energy-saving devices for fishing vessels, alternative energy sources such as solar power, or energy-related standards covering automobile engine efficiency performance standards. Such measures have been primarily made under the TBT Agreement and Agreement on Subsidies and Countervailing Measures (SCM). In addition, a TRIMs notification lists alternative energy sources "like solar, wind, etc., and equipment thereof" including energy-efficient lamps, although no reference is made to environmental objectives. One notification under the SCM Agreement lists support of agricultural processing, including assistance in the "application of modern packaging procedures as well as energy savings and environmentally-sound technologies". There are also TBT notifications on labelling and certification of electric motors for energy efficiency objectives; labelling requirements for energy-efficiency standards covering air conditioners. Other notifications included information on assistance in support of the research, development and diffusion of cleaner technologies, including energy efficient technologies, waste reduction technologies, the use of renewable energy as a means of reducing negative environmental impacts linked to traditional energy use.

61. One estimate of annual energy subsidies in developed countries is in the vicinity of US$70 to US$80 billion per year.[62] In Eastern and Central Europe electricity subsidies range between US$34 to US$39 billion per year, although overall energy subsidies in this region have been decreasing.[63] For developing countries, overall energy subsidies are estimated to be in excess of US$150 billion per year, of which electricity consumption subsidies exceed US$100 billion.[64] An estimate of energy subsidies based on a survey conducted in 60 developing countries shows that electricity rates are as low as US$0.038 per kilowatt hour on average, or less than half of the electricity rates applied in developed countries. Electricity rates for 80 per cent of the utilities surveyed do not cover long run marginal cost.[65]

---

[62]A. de Moor (1997), *Subsidizing Unsustainable Development*, Amsterdam: Institute for Research and Public Expenditure.

[63]B. Larsen and A. Shah (1992), "World Fossil Fuel Subsidies and Global Carbon Emissions", in the *World Development Report*, Washington: World Bank.

[64]*See* World Bank (1997), *Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development*, Washington: World Bank. It should be noted that a significant, although unquantified proportion of total developing country energy subsidies were directed at low-income households to reduce kerosene prices (an important energy source in many low-income households in developing countries) or to lower diesel fuel prices.

[65]World Bank (1997), *Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development*, Washington; R. Saunders and S. Gandhi (1993), *A World Bank Policy Paper: Energy Efficiency and Conservation in the Developing World*; and World Bank (1990), *Review of Electricity Tariffs in Developing Countries During the 1980s*, Energy Series, Paper No. 32, Washington: World Bank.

62. It is considered that among the main energy sources which are subsidized, subsidies to coal and renewable energy are the most prevalent. It should be emphasized that other sources of energy production also receive subsidies and other indirect support (e.g. infrastructure support). However, subsidies applied to different sources of primary energy production are difficult to quantify.[66] As a case study this section provides more detailed information on the coal sector. Almost all OECD countries with indigenous coal production support their coal industry. The International Energy Agency (IEA) has calculated total public support to the coal industry in its member countries using the Producer Subsidy Equivalent (PSE). PSE is calculated as the subsidy needed to make coal production competitive in an unregulated market, and is based on the following two elements: (a) direct and financial aid to current production, including investment grants, deficit grants, and support to miners' pension funds, and (b) price support.[67] The following table provides an indication of the total PSE in some countries for coal.[68]

Producer Subsidy Equivalent for Coal
(in Million US$)

COUNTRY	1993	1994
Germany	7776	8025
United Kingdom	1615	345
Japan	1082	n.a.
Spain	586	962
Belgium	50	nil
France	165	n.a.
Total PSE	9191	---

Source: ECON Senter for Okonomisk Analyse (1996), *Energy Taxes; Trends and Structures in OECD and Selected non-OECD countries*, Report No. 44/96, Oslo.

63. Coal subsidies have contributed to maintaining inefficient domestic production, and reducing imports of other fuels. Subsidies have also encouraged the use of coal resources, and increased the use of coal in electricity production. According to the ECON Centre for Economic Analysis, "more coal fired power plants have been constructed in the past and maintained in operation than would have been the case without the subsidization and the protection of domestic coal production".[69] As far as subsidies for renewable energy are concerned, almost no information exists on their magnitude.

(b) Taxes

64. Energy taxes are an important source of revenue for governments and take a variety of forms.[70] They include: (a) motor fuel taxes, (b) electricity taxes, (c) severance taxes, (d) pipeline taxes, (e) natural

[66]ECON Senter for Okonomisk Analyse (1996), *Energy Taxes; Trends and Structures in OECD and Selected non-OECD countries*, Report No. 44/96, Oslo.

[67]Ibid.

[68]It is important to note is that in certain OECD countries, coal subsidies amount to almost four times the cost of imported coal (based on 1994 data). *See* ECON Senter for Okonomisk Analyse (1996), *Energy Taxes; Trends and Structures in OECD and Selected non-OECD countries*, Report No. 44/96, Oslo.

[69]ECON Senter for Okonomisk Analyse (1996), *Energy Taxes; Trends and Structures in OECD and Selected non-OECD countries*, Report No. 44/96, Oslo.

[70]*See*, for example, OECD (1997), *Evaluating Economic Instruments for Environmental Policy*, Paris.

gas taxes, and, more recently (f) carbon taxes. A number of rationales are advanced to support the use of these taxes, such as compensating the public for land-use (this rationale is rooted in the belief that sub-surface resources belong to the state, and that mining and oil companies must compensate the state when these resources are appropriated for private use), using these taxes as a proxy for user fees or toll charges on roads and highways, and paying for adverse environmental or health effects associated with either the mining, transportation, storage or consumption of fossil fuels.[71]

65. One survey has found that in OECD countries, oil is taxed more than other sources of energy (e.g. natural gas or coal). Between 1980 and 1995, the average tax on oil doubled in the OECD. For OECD countries as a whole, the average tax on natural gas was US$1.3 per barrel of oil equivalent. The average OECD tax on coal is identified as low. The same survey identified certain trends in energy taxation 14 in non-OECD countries. Most of the countries surveyed have brought the prices of oil products closer to international market prices. In general, their taxes on oil products tend to be lower than those in the OECD, but follow the pattern of higher taxes on light petroleum products, and lower taxes on heavy ones. While natural gas prices are controlled, they do not deviate significantly from international prices.[72]

C. Environmental Benefits

66. It is generally felt that the removal of subsidies and the restructuring of taxes to bring energy prices in line with marginal social costs could result in significant environmental benefits. Clean technologies, co-generation gas turbine combined cycles, steam-injected gas turbines, increased reliance on renewable energy sources, and demand-side management are among the menu of options which will be important in improving the environmental profile of energy in addition to changes in relative prices.[73]

67. In the past thirty years, environmental policy has addressed the adverse environmental implications of energy production and use. An extensive body of literature exists identifying different aspects and magnitudes of environmental problems in the sector, which is too broad and detailed to summarise in this Note. It is worth noting, however, that different types of energy sources raise different environmental issues both at the production and consumption stages. Comprehensive domestic and international environmental policies have emerged to address externalities linked to energy use, and include command and control and economic-based measures to reduce emissions of sulphur dioxide, suspended particulate matter, nitrous oxide, carbon monoxide, carbon dioxide, light hydrocarbons, organic and inorganic aerosols, as well as toxins produced in certain combustion methods.

68. International cooperation to address air pollution includes the 1979 Geneva Convention on Long-Range Transboundary Air Pollution and subsequent protocols concerning sulphur dioxide, and the 1992 Framework Convention on Climate Change. At the nineteenth Special Session of the UN General Assembly (June 1997), an open-ended Intergovernmental Group of Experts on energy and sustainable development was established. In addition, the General Assembly noted the "need to encourage the reduction and gradual elimination of subsidies for energy production and consumption that inhibit sustainable development. Such policies should take fully into account the specific needs and conditions of developing countries, particularly least-developed countries, as reflected in the special and differential

[71]Muller et. al. (1994), "Greening State Energy Taxes: Carbon Taxes for Revenue and the Environment", in *Pace Environmental Law Review*, Vol. 12, No. 1.

[72]ECON Senter for Okonomisk Analyse (1996), *Energy Taxes; Trends and Structures in OECD and Selected non-OECD countries*, Report No. 44/96, Oslo.

[73]*See* M. Munasinghe (1995), *Sustainable Energy Development: Issues and Policy*, Paper No. 16, Washington: World Bank.

treatment accorded them in the Uruguay Round of Multilateral Trade Negotiations Agreement on Subsidies and Countervailing Measures."

69. Environmental externalities have also been extensively analyzed with regards to energy production. To illustrate, environmental impact assessment procedures have for many years identified and helped to mitigate problems linked to the construction and operation of hydro-electric dams. Assessments weigh longer-term environmental impacts of flooding and river diversion on eco-systems, associated loss of fragile wildlife habitats including wetlands, marshes and old-growth forests, the loss of biodiversity as well as unforeseen changes in wildlife migration and feeding patterns, upstream changes in watersheds and ground water aquifer levels, longer-term problems associated with siltation culmination, as well as environmental problems related to the electricity transmission along corridors. Other energy sub-sectors pose equally acute environmental problems. Oil exploration, oil refining, petro-chemical operations, and oil transport pose different problems, such as land degradation, toxic pollution or spills from marine transport accidents. The mining of coal presents problems similar to other types of mining, including changes in land-use, the degradation of adjacent rivers and lakes with various pollutants including sludge, and air quality problems associated with various air pollutants. Environmental problems associated with nuclear energy have been long recognised, and include operational risks as well as acute waste treatment problems.

70. By distorting prices, energy subsidies exacerbate environmental problems linked to energy production and use. For example, some energy subsidies may encourage the inefficient use of energy resources, discourage energy conservation or the expanded use of renewable sources. In addition, subsidies may encourage obsolete and environmentally-inefficient technologies (e.g. older coal-fired utilities which operate below peak thermal efficiency) to continue operation. However, caution is required when drawing conclusions about the environmental impact of energy policy reform.[74] Two factors which determine the impact of reforming energy subsidies on the environment include: (a) the responsiveness of input use to changes in subsidies; and (b) the amount of damage caused by each unit of input used. While it is usually assumed that the removal of energy subsidies would result in decreased energy consumption and an improved environmental situation, to reduce subsidization may not substantially reduce energy consumption because: (a) as energy is an input to virtually all forms of economic activity, subsidy removal is likely to have general equilibrium effects, making predictions about the impact of reforms on the environment difficult to make; (b) where inter-fuel substitution is possible, reduced subsidies may affect the composition rather than the quantity of fuel used (environmental damage would in this case depend on the composition of the fuels that continue to be used).

71. Different environmental effects have also been identified in the energy sector because of trade liberalization. According to one study, the benefits that would follow from the removal of trade distortions and restrictions facing primary fossil fuels over the period 1990-2000 have been estimated to be significant.[75] Changes induced by the reform are compared to "Business as Usual" (BaU), a situation in which no reform is undertaken. In the BaU scenario, depletion of crude oil reserves takes place from the year 2030 onwards, and crude oil is progressively replaced with carbon-intensive synthetic fuel. Carbon dioxide emissions in the OECD increase faster post 2030, reflecting the replacement of conventional oil products by synthetic fuel which emits more carbon dioxide per unit of energy into

[74]These arguments are developed in World Bank (1997), *Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development,* Washington: World Bank.

[75]Ibid.

the atmosphere. Such a replacement does not occur in non-OECD countries, where significant oil subsidies make synthetic fuel unprofitable.[76]

72. When existing trade restrictions and distortions are removed, energy demand in the non-OECD countries falls by 28 per cent (compared to the BaU scenario) as a result of removing subsidies, but energy demand increases by 21 per cent in OECD countries due to the elimination of taxes. For the world as a whole, however, primary energy demand declines by 16 per cent. Moreover, when subsidies are removed, the most polluting fuels (coal and carbon based synthetic fuels) are replaced by crude oil. The impact of removing existing distortions on world emissions is thus significant. Based on the model described here, whereas in the year 2050 19.3 billion tons of carbon would be released in the BaU scenario, only 15.9 billion tons would be released with total reform.

73. A number of developing countries rely heavily on coal as a source of energy.[77] It has been argued that for developing countries, phasing out fuel subsidies should be a principal target to reduce environmental impacts. In these countries, such reforms would enable the first units of abatement to be achieved at zero, or even negative (welfare enhancing) cost.[78] In addition, the study argues, that where existing energy taxes are distortionary, they should also be reformed. Current fuel taxes fall heavily on only one fossil fuel, namely oil. The introduction of carbon taxes (to address the problem of global warming) on existing distortionary taxes, would only increase welfare costs.

74. In addition, it is possible that the removal of subsidies on fossil fuels in some cases may increase demand for wood fuel. This provides a caveat to some of the expected environmental benefits from subsidy reform. Increased wood fuel consumption could accelerate deforestation, and contribute to both land degradation and the loss of habitats. However, it is expected that wood fuel would only substitute for a narrow range of other fuels, and would only be employed for household consumption (heating and cooking). In addition, the use of wood fuel by urban households is likely to be constrained by space and transport cost considerations. Therefore, deforestation may not increase significantly as a result of reforming fossil fuel subsidies.[79] Reforms in other sectors may also affect energy use and environmental impact. For example, anthropogenic emissions of nitrous oxides originate from agriculture, and in particular chemical fertilizers: agriculture is the largest single source of N_2O emissions of the reporting Parties to the Framework Convention on Climate Change.[80] The FCCC also notes that subsidy reform would be expected to decrease emissions of methane gas from coal mining operations.

75. In discussing the effects of reforming energy taxes and subsidies, the income effects of trade liberalization on the environment in the energy sector are also potentially important. Several studies suggest that eliminating energy subsidies will increase real income globally by three quarters of one per cent (which is comparable to the order of magnitude of the contribution of the Uruguay Round to increased global GDP).

---

[76]Ibid.

[77]China and India, which together account for approximately 14 per cent of global carbon dioxide emissions, rely heavily on coal.

[78]*See* R. Clarke (1993), "Energy Taxes and Subsidies: Their Implications for CO2 Emissions and Abatement Costs", *International Journal of Environment and Pollution*, Vol. 3, No. 1/3.

[79]*See* World Bank (1997), *Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development,*Washington: World Bank.

[80]Framework Convention on Climate Change (1997), *National Communications*, FCCC/SB1/1997/19, Bonn: Subsidiary Body for Implementation.

(a) Coal

76. Coal is widely viewed as being among the more polluting sources of energy. Its mining and consumption result in a multitude of local and global environmental problems.

77. Differences between international and domestic prices of coal are maintained through a number of trade restrictions and distortions, some of which include: (a) restricting imports to raise the domestic price of coal; (b) directly subsidizing coal; and (c) imposing minimum purchasing obligations on electricity generating utilities, requiring them to buy certain volumes of coal from local mines at above international prices.[81] Coal subsidies are considered to be a major problem from an environmental perspective and the environmental benefits of removing coal subsidies may be numerous. For example, there are local and global environmental problems associated with coal mining: the burning of coal releases carbon and sulphur dioxides into the atmosphere which contributes to global warming and acid rain. Evidence supports the fact that reducing subsidies would decrease coal consumption.[82] In fact, where subsidies to producers have decreased world prices of coal, reversing this policy is expected to increase international prices and contribute to decreased demand for coal. This would reduce the local and global environmental problems associated with the mining and use of this energy source.[83]

78. There is also evidence to suggest that differences in energy prices across the world are due to government measures to either tax or subsidize energy. While OECD countries implicitly tax carbon in oil products (with taxes exceeding US$200 per ton of carbon), non-OECD countries implicitly subsidize carbon (with the implicit subsidy averaging US$92 per ton of carbon).[84] It has been argued, for example, that reforming these taxes and subsidies would contribute significantly to combating global warming.[85]

(b) Metals

79. As noted, reforming trade distorting policies in the energy sector will have an impact on all economic activities that use energy. Among the many sectors which will be affected by the removal of energy subsidies and tariff reductions is the mining sector. As non-ferrous metals are addressed separately in this note, special mention of the inter-linkages between minerals, energy and the environment is made below.

80. Anything which is extracted, recovered, or mined from the earth, and which is mostly inorganic, can be considered a mineral. Minerals can be classified into four different categories[86]:

(i) minerals that are not consumed after extraction and chemical processing. These include most metal ores, such as iron, copper and bauxite, which are used for making steel,

---

[81]*See* K. Anderson (1995), "The Political Economy of Coal Subsidies in Europe", *Energy Policy,* Vol. 23, No. 6.

[82]Ibid.

[83]It is important to note is the fact several countries in Western Europe have already chosen to abandon coal subsidies, and a number of others are also expected to do so in the near future, so that the process of removing trade restrictions and distortions facing this energy source has already begun. *See* K. Anderson (1995), "The Political Economy of Coal Subsidies in Europe", *Energy Policy*, Vol. 23, No. 6.

[84]*See* P. Hoeller and J. Coppel (1992), "Carbon Taxes and Current Energy Policies in OECD Countries", *OECD Economic Studies;* in *The Economic Costs of Reducing CO2 Emissions*, No. 19, Paris: OECD.

[85]*See* OECD (1992), *Environmental Impacts of Renewable Energy,* The OECD Compass Project, Paris: OECD.

[86]*See* J. Tester et. al., ed., (1991), *Energy and the Environment in the 21st Century,* Cambridge: MIT Press.

copper and aluminum respectively. These are the principal metals which form the backbone of industrial activity;

(ii) minerals that are consumed and not recycled. These are referred to as industrial minerals. Some, such as potash and phosphate, are used to make fertilizers and are lost after their use. Limestone, which also falls in this category, is used to make cement, and is rarely recycled;

(iii) energy minerals. The main mineral in this category is coal, which is consumed to fulfil different energy requirements. Minerals containing uranium also fall into this category; and

(iv) minor minerals and ores that are required for various applications in the industrial world. Examples of these minerals include: rare earths that are used in electronics, and gold.

81. A significant amount of energy is required to concentrate and treat minerals in order to produce intermediate products for further chemical processing, which also consumes energy. When minerals attain a semi-usable form, such as copper, metal or steel, additional energy is required to turn these metals (by thermo-mechanical means) into useful products. As set out in more detail in Section VI on non-ferrous metals, the production of minerals, therefore, is energy intensive.

Energy Consumption Profile

INDUSTRY	ENERGY REQUIREMENT (10^6 Btu/ton)
Copper	80-100
Nickel (sulfide ore)	200
Zinc	60
Lead	30
Steel	27-30
Nickel (laterite ore)	600
Aluminum	280
Glass	7.4
Lime	6-8
Cement	7.6

Source: Jefferson Tester et. al. (1991), *Energy and the Environment in the 21st Century*, Cambridge: MIT Press.

82. The removal of trade restrictions and distortions in the energy sector, accompanied by appropriate environmental policies, will send correct signals to the minerals industry. Energy subsidies encourage the overuse of energy, and provide an implicit subsidy to all mineral production activities. It has been suggested that reforming these subsidies could reduce energy consumption and promote more efficient and environmentally sustainable minerals production.

IV. FISHERIES

A. Overview

83. The fisheries sector is comprised of two broad categories: (a) capture fisheries which encompass the harvesting of wild fish stocks; and (b) aquaculture which refers to the production of aquatic organisms. Aquaculture accounts for 18 per cent of total world fish production by weight. The principal focus of this section is capture fisheries, which the FAO subdivides into industrial fisheries and artisanal fisheries.

84. The FAO estimates that in 1995 the total global production of fish was 112 million metric tonnes (m.m.t.) per year, of which total capture fisheries represented 91 m.m.t. and total aquaculture represented 21 m.m.t.. Ten countries accounted for about 70 per cent of the volume of landing of capture fisheries in 1995, with the contribution of total production in low-income food importing countries increasing significantly. In 1995, these countries accounted for 35 per cent of total production, compared with 26 per cent in 1988. Fish supplies for human consumption and fishmeal production have reached record levels. Of the total production of fish in 1995, approximately 81 m.m.t. is used for human consumption, and 31 m.m.t. is consumed for other uses such as cattle and aquaculture feed.[87]

85. Large scale industrial fisheries, which constitute three-quarters of world catch, are predominately capital-intensive and use advanced technologies to locate migratory fish stocks and require complex infrastructures to land and process fish.[88] Industrial fisheries are dominated by developed countries, and involve the full spectrum of fish species, from those that are of high-value, such as tuna, cod and haddock, to those which are lower in value but greater in abundance fish species. The latter are used primarily for fishmeal. Small scale, artisanal fisheries represent one-quarter of total annual catch, and are the dominant fishing sector in many countries. Small-scale fisheries are concentrated in coastal and inland waters, and supply fish and fish products predominately for local consumption.[89]

86. Approximately one-third of global fish production enters international trade and is concentrated primarily on high-value fish and fish products.[90] It is estimated that the total value of trade in 1995 was US$ 51.7 billion, which represents a significant increase from the total of US$ 17 billion in 1985. It is estimated that this increase is due largely to an increase in trade in low-value fish products, such as, for example, fishmeal. Trade patterns for high-value fish products are dominated by imports to developed countries, of which approximately half originates in developing countries. An estimated 87 per cent of industrialized countries' exports of fish and fish products, measured in terms of market value, were destined for other developed countries. The total value of exports from developing nations, for whom fisheries represents a significant source of export revenue, increased from US$ 5.1 billion in 1985 to US$ 20 billion in 1995.

---

[87]FAO (1996), *The State of World Fisheries and Aquaculture*, Rome.

[88]Large or industrial fishing vessels can catch as much as 400 tonnes of fish in large nets, and are capable of processing 50-80 tonnes of fish per day. Although industrial vessels represent only one per cent of the world's total fishing fleet, they account for approximately 60 per cent of the total registered tonnage of fishing vessels. *See* G. Porter (1997), *The Euro-African Fishing Agreements: Subsidizing Overfishing in African Waters*, UNEP-WWF Workshop on the Role of Trade Policies in the Fishing Sector, Geneva.

[89]R. Grainger (1996), *Recent Trends in Global Fishery Production*, FAO, Rome; FAO (1996), *The State of World Fisheries and Aquaculture*, Rome; and The Ministry of Foreign Affairs of the Netherlands (1995), *Fisheries in Developing Countries: Towards sustainable use of living aquatic resources*, Hague.

[90]Data from FAO (1997), *The State of Food and Agriculture*, Rome.

87. Scientific evidence has consistently shown a downward trend in the world's fish stocks.[91] Fisheries have developed rapidly, with the result that there are now few under-exploited resources and an increasing number of overexploited ones. On a worldwide basis, the FAO estimates that 60 per cent of the 200 major fish species are fully exploited, overfished or in the process of rebuilding as a result of depletion. Scientific estimates show a dramatic decline or collapse in several high-value fish stocks. For example, one estimate suggests a decline between 1992 and peak-year yields for Atlantic Cod in the vicinity of 69 per cent, for Cape Hake by 82 per cent, for Haddock by 80 per cent, for Silver Hake by 88 per cent, for Greater Yellow Croaker by 80 per cent, and for Atlantic Herring by 63 per cent.[92] The FAO notes that the depletion of various fish stocks has occurred in virtually all coastal states throughout the world.[93]

88. By all accounts, the world's fisheries resources continue to undergo an alarming deterioration, whereby the extent of annual harvesting worldwide is undermining the sustainability of fisheries resources.[94] Factors which explain fish stock decline are many and varied and include overcapacity and overfishing of fishing fleets, open access to fish resources as a result of the absence of property rights for fisheries resources, inappropriate fisheries management practices, marine pollution, fish by-catch mortality, and increased ultra-violet radiation on marine food chains.[95] Access to fish stocks, particularly certain high-value fish species which are found either outside the Exclusive Economic Zones (EEZs) or which migrate between EEZs and the high seas, is an area of concern. Concern also has been raised about the adverse conservation impacts associated with large fishing operations and the use of floating driftnet devices which increase mortality of non-commercial fish and marine mammal by-catch[96], and affect marine biodiversity and their habitats.[97]

B. Trade Restrictions and Distortions

Trade in fish and fish products is affected by tariff and non-tariff measures, including quotas, embargoes, license requirements, and sanitary and phytosanitary and technical standards.

---

[91]FAO (1996), *Chronicles of Marine Fishery Landings (1950-1994): Trend analysis and fisheries potential*, Fisheries Technical Paper No. 359, Rome.

[92]FAO (1996), *The State of World Fisheries and Aquaculture*, Rome. *See* also G. Porter (1997), *Fishing Subsidies, Overfishing and Trade*, UNEP Environment and Trade Series No. 15; and P. Weber (1994), *Net Loss: Fish, Jobs and the Marine Environment*, Washington: Worldwatch Paper No. 120.

[93]FAO (1997), *Marine Fisheries and the Law of the Sea: A Decade of Change*, Rome.

[94]Fisheries management is one of the oldest areas of international law. For example, the International Council for the Exploration of the Sea was established in 1902 to facilitate the exchange of scientific data on fisheries. The concept of maximum sustainable yield (MSY) for harvesting fisheries resources was defined in 1958 and its development was a precursors to the concept of sustainable development which came out of UNCED. The concept of MSY deals with the output per unit of effort, i.e. level of fish resources which can be harvested annually from a self-regenerating stock of fish species while maintaining a sustainable stock. *See*, for example, A. de Fontaibert, D. Downes and T. Agardy (1996), *Biodiversity in the Seas*, IUCN Environmental Policy and Law paper No. 32; and P. Birnie and A. Boyle (1992), *International Law and the Environment*, Oxford: Oxford University Press.

[95]UNEP (1997), *The Role of Trade Policies in the Fishing Sector: Summary Report*, UNEP/WWF workshop on "The Role of Trade Policies in the Fishing Sector", Geneva; and R. McLeod (1996), *Market Access Issues for the New Zealand Seafood Trade*, New Zealand Fishing Industry Board.

[96]FAO estimated (1994) that on average 27 million tonnes of fish landings consisted of by-catch, representing an average of approximately 32 per cent of total reported annual production of marine capture fisheries; incidental catch of non-targeted, vulnerable species is associated in particular with shrimp, prawn and tuna fisheries.

[97]*See* A. de Fontaibert, D. Downes and T. Agardy (1996), *Biodiversity in the Seas*, IUCN Environmental Policy and Law paper No. 32; and P. Birnie and A. Boyle (1992), *International Law and the Environment*, Oxford: Oxford University Press.

(a) Tariffs

89. It has been estimated that approximately 80 to 85 per cent of total international trade in fish and fish products are bound under MFN tariffs; the remaining 20 per cent fall under GSP and other preferential trade arrangements.[98] In developed countries, pre-Uruguay Round tariffs averaged 6.1 per cent weighted by imports from all sources and 6.6 per cent when weighted by imports from developing countries. The average trade weighted post-Uruguay Round tariff levels for three major markets in the fisheries sector are (on a trade weighted basis) 10.7 per cent for the European Union, 4.1 per cent for Japan, and 0.9 per cent for the United States. Post-Uruguay Round average rates have been reduced to 4.5 per cent and 4.8 per cent respectively. One estimate forecasts that the increase of fish and fish products exports due to trade liberalization will range from 12.9 to 13.5 per cent.[99]

90. Tariff reductions as a result of the Uruguay Round are slightly more pronounced for unprocessed products compared to processed products. Accordingly, tariff escalation is still perceived to be a problem faced by many exporting countries. Higher tariff rates applied to semi-processed or processed fish products induces allocative inefficiencies both in the country imposing the tariffs, and in the exporting countries. From a global perspective, these inefficiencies have resulted in a larger absolute quantity of unprocessed fish being exploited to produce the same volume of processed fish.

(b) Subsidies

91. Subsidies in the fisheries sector assume a variety of forms and are primarily provided to reduce operating and capital costs of harvesting. Subsidies include those provided to reduce operating costs, reduce fishing vessel construction or maintenance costs, or those provided indirectly by way of income support and as part of fisheries management schemes.[100] Subsidies to reduce vessel fuel costs can contribute to the loss of high-migration or straddling stocks by encouraging long-range harvesting, while subsidies to vessel construction will increase total fleet capacity. There are direct subsidies based on total output and measured in terms of days at sea or as a percentage of total catch and subsidies on a fleet's idle capacity. In addition, under bilateral coastal access agreements, fishing licenses are in many instances considerably undervalued compared to the commercial catch and can be considered to constitute an indirect subsidy, particularly if a quota management system is not in place or not adequately enforced.[101]

92. Subsidies also have the potential to contribute to sustainable fisheries management schemes. Examples include subsidies to reduce fleet capacity, retrain fisher people, enhance fish stocks, promote vessel and fishing buy-backs to take vessels out of use, and encourage technological improvements. Determining the impact of subsidies which are deemed to be environmentally-beneficial will depend on how these subsidies are administered and monitored. Recent literature suggests that in some cases,

[98]Approximately 300 bilateral fishing-related agreements have been signed in the last two decades.

[99]GATT (1994), *The Results of the Uruguay Round of Multilateral Trade Negotiations, Market Access for Goods and Services: Overview of the Results,* Geneva.

[100]The FAO Committee on Fisheries has identified excessive fishing capacity and inappropriate fishing management as a major problem for all governments. *See* FAO (1997), *Report of the 22nd Session of the FAO Committee on Fisheries,* Rome.

[101]*See*, for example, G. Porter (1997), *The Euro-African Fishing Agreements: Subsidizing Overfishing in African Waters,* UNEP-WWF Workshop on the Role of Trade Policies in the Fishing Sector, Geneva: UNEP.

for example, subsidies for vessel buy-backs may succeed in retiring old boats, but that these may be replaced by new ones.[102]

93. Although the precise identification and quantification of subsidies in the fisheries sector has not yet been fully undertaken, consensus exists that fisheries subsidies are widespread, trade distorting and undermine the sustainable use of fish resources. One often cited estimate suggests that the order of magnitude of subsidies to the fisheries sector world wide is in the vicinity of US$54 billion per annum, representing 77 per cent of the total value of fish harvested by the world's fishing fleet.[103] Although this estimate has been subject to criticism, it nonetheless remains a useful point of reference.

94. Work is currently underway in various fora to identify, classify and quantify different types and effects of subsidies. For example, The UNGASS concluded that there was a need for governments to consider the positive and negative impact of subsidies on the conservation and management of fisheries through national, regional and appropriate international organizations and, based on these analyses, to consider appropriate action.[104] At its 79th Session in April 1997, the OECD Fisheries Committee agreed to study government financial transfers that affect the transition to responsible fisheries.[105] The Committee noted that it is inappropriate to classify various transfers as either "good" or "bad" subsidies, but rather to analyze the relationship between such transfers, fishing capacity and fishing activities, and fish stock status.[106]

95. Several environment-related fisheries subsidies have been notified by Members: these include regional structural adjustment programmes for fisheries in which conservation objectives are identified; various fisheries support schemes in which environmental conservation is cited; and support schemes to promote environmentally-sound fish harvesting methods.[107]

(c) Non-tariff measures

96. Trade in fish and fish products is subject to non-tariff measures including tariff quotas, quantitative restrictions, import levies and sanitary and phytosanitary and technical regulations. Non-tariff measures have been notified by Members under different WTO Agreements, including the Agreements on Sanitary and Phytosanitary Measures (SPS) and Technical Barriers to Trade (TBT). A number of measures have been notified by Members under the SPS Agreement, including quarantine requirements, standards related to fish additives, food safety standards (e.g. the use of preservatives in various fish products), criteria related to fish health (e.g. certification for ornaments fish and fish products), and notifications which refer to international standards and agreements (e.g. the Fish Disease Commission and CITES).

---

[102]J. Gates, D. Holland and E. Gudmundsson (1997), *Theory and Practice of Fishing Policies and Vessel Buy-back Programmes*, paper submitted to the UNEP/WWF workshop on "The Role of Trade Policies in the Fishing Sector", Geneva: UNEP.

[103]D. Doulman (1996), *An Overview of World Fisheries: Challenges and Prospects for Achieving Sustainable Resource Use.*

[104]UN (1997), *Programme for the Further Implementation of Agenda 21*, (E/1997/MISC.3) text adopted at the nineteenth Special Session of the General Assembly, Geneva.

[105]The OECD expects to complete this study in 1999.

[106]OECD (1997), *Impact on Fisheries Resource Sustainability of Government Financial Transfers*, Fisheries Committee of the Directorate for Food, Agriculture and Fisheries, Paris.

[107]*See* WT/CTE/W/46.

97. Various types of quota restrictions and import licensing procedures have been notified by WTO Members under the Agreement on Import Licensing Procedures, and include licensing schemes covering live fish, fresh fish, chilled or frozen fish; the control of imports of certain types of fish species (such as flying fish or associated pelagics); import controls on fish products used for animal feed and quantitative restrictions on the import of smoked trout, cod, salmon, lobster, scallops. Under the TBT Agreement, labelling requirements have been notified concerning, for example, canning methods for fish products, or standards which do not allow canned products to contain juvenile species. There have also been notifications of marketing arrangements, packaging requirements, internal taxes on fish products, technical regulations and standards covering minimum landing size of fish, and physical criteria (such as whether the fish is carrying eggs).[108]

C. Environment Benefits

98. The fisheries sector is a good example of the benefits for both trade and environment of removing trade distortions. To a certain extent, however, the contribution of eliminating trade restrictions and distortions in the fisheries sector is difficult to isolate relative to the numerous other factors affecting the sector. For the most part, it is fisheries management, and not trade, which plays the crucial role in determining sustainable resource exploitation.

99. As set out in the submissions to the Committee on Trade and Environment by New Zealand and the United States, an important cause of the decline in fish stocks is overfishing due to overcapacity in production and fleets.[109] A recent UNEP workshop also noted that the fish crisis is largely a problem of overcapacity of fishing fleets on a global scale where there exists too much fishing capacity for too few fish stocks.[110] This situation has arisen as a result of the mismanagement of fish stocks to the point where their economic productivity and environmental sustainability has been severely undermined.[111] Over the past several decades, the FAO estimates the capacity of the world's fishing fleet has increased threefold. Increases in the number of fishing vessels and significant changes in fishing boats and harvesting methods have contributed to fishing beyond what are considered to be sustainable limits. Fisheries management at the national and international levels is viewed as being crucial in determining the levels of sustainable resource exploitation.

100. The measurement and quantification of the effect of trade distortions, such as subsidies, is complex. However, it is argued that removing subsidies would increase operating, capital or other costs and contribute to less overfishing by reducing overcapacity in the fishing sector. With the exception of the potentially environmentally-enhancing subsidies noted above, the positive effects that would follow from the elimination of subsidies include an increase in capital or operating costs for new entrants in the sector. A reduction in capital-related subsidies would limit the adoption of advanced technologies than would otherwise be adopted; some of these technologies dependent on economies of scale. A reduction of capital-related subsidies would in some instances also reduce the range of fleets. A reduction of subsidies provided to idle vessels, for example, would reduce the ability of inefficient producers to continue operating, and encourage the phasing out of obsolete and potentially environmentally-damaging equipment. In the absence of income support and with an increase in capital and operating

[108]Ibid.

[109]*See* the submissions by New Zealand (WT/CTE/W/51) and the United States (WT/CTE/W/52).

[110]UNEP (1997), *The Role of Trade Policies in the Fishing Sector: Summary Report*, UNEP/WWF workshop on "The Role of Trade Policies in the Fishing Sector", Geneva.

[111]The fisheries sector underlines the close relationship between environmental science and economics. Viable fisheries production depends on existing fish stocks or biomass. Sustainable fish yields are linked to the level of resource biomass in such a way that the level of fisheries production should correspond to the level of the available biomass. Production will decline when the maximum sustainable yield of fish stocks is surpassed.

costs of fisheries harvesting operations, short-term profit margins would decrease as would returns on investment, thereby also encouraging the accelerated retirement of inefficient operators, and an overall reduction in fleet capacity.[112] Considerably more work is needed in tracking and understanding trends in world prices for high value species, for example, and the role which price distorting policies, such as subsidies, play in fisheries trade.

101. Subsidies removal will not in itself ensure the sustainable use of fish resources; it represents a necessary step towards removing the most prevalent economic instrument hampering the achievement of sustainable fisheries management. As in other sectors, the introduction of appropriate domestic and international environmental and conservation policies are needed, and the removal of trade restrictions and distortions is but one element in that regard. Nevertheless, the reduction or elimination of trade restrictions and distortions, such as subsidies, is an important prerequisite towards building sustainable fisheries management, particularly given the extent to which such subsidies distort world prices and impact negatively on sustainable resource use.[113]

102. Since UNCED, the multilateral framework for sustainable use and conservation of living aquatic resources in the oceans has been enhanced. Chapter 17 of Agenda 21 of UNCED addressed the "Protection of the oceans, all kinds of seas, including enclosed and semi-enclosed seas, and coastal areas and the protection, rational use and development of their living resources." Multilateral developments of relevance to fisheries, include the entering into force in 1996 of the UN Convention on the Law of the Sea (UNCLOS), which establishes exclusive economic rights over 200-mile coastal zones.[114] Other examples of multilateral agreements related to fisheries are the 1992 UN Framework Convention on Biological Diversity[115]; the 1993 Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas; the 1995 Agreement for the Implementation of the Provisions of the UNCLOS relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks; and the 1995 FAO Code of Conduct for Responsible Fisheries and the UN Moratorium on Driftnet Fishing.[116]

103. It has been widely recognized that fishing subsidies are a major contributor to the current state of fleet overcapacity and to the mismanagement of fisheries resources. Although it also has been recognized that sustainable fisheries management goes beyond removing subsidies, the UNEP workshop

---

[112]S. Sen (1994), "The Environmental Effects of Trade in the Fisheries Sector", in C. Runge, ed., *The Environmental Effects of Trade*, Paris: OECD.

[113]*See* FAO (1996), *The State of World Fisheries and Aquaculture*, Rome; OECD (1996), *The Economic Aspects of Management of Living Marine Resources*, Fisheries Committee; and the submissions to the WTO Committee on Trade and Environment by New Zealand (WT/CTE/W/51) and the United States (WT/CTE/W/52).

[114]The 1982 UNCLOS assigns to coastal states the exclusive right to manage and exploit marine resources, including living resources, in their exclusive economic zone (EEZ: 200 nautical miles from the base line from which the breadth of the territorial sea is measured) and apply regulatory measures within the framework of a comprehensive management system. Attached to these rights are certain obligations with respect to the conservation and utilization of the living resources. The coastal state determines the allowable catch based on the best scientific evidence available. If a coastal state does not have the capacity to harvest the entire allowable catch, it shall give other states access to the surplus of the total allowable catch in return for fishery-related economic benefits. However, as not all fish stocks are found within EEZ, UNCLOS directs the coastal state and other states fishing in the region to cooperate directly or through appropriate international organizations with a view to ensuring conservation and promoting the objective of optimum utilization of such species throughout the region, both within and beyond the EEZ. *See* United Nations (1983), *United Nations Convention on the Law of the Sea*, New York.

[115]Of particular relevance is the Jakarta mandate on Coastal and Marine Biodiversity adopted at the second session of the Conference of the Parties of the Convention on Biological Diversity in November 1995.

[116]UN (1997), *The Report of the Secretary-General on the Protection of the oceans, all kinds of seas, including enclosed and semi-enclosed seas, and coastal areas and the protection, rational use and development of their living resources*, (E/CN.17/1996/3) text adopted at the nineteenth Special Session of the General Assembly, Geneva.

came to a general agreement on the need to roll back subsidies to the fishing sector, for both environmental and economic reasons.[117] The UNEP workshop recommended that a variety of institutional options for disciplining counterproductive fishing subsidies, including action within the WTO, under existing environmental agreements, or through negotiation of a new accord. The UNGASS agreed on the need for: "Governments to prevent or eliminate overfishing and excess fishing capacity through the adoption of management measures and mechanisms to ensure the sustainable management and utilization of fishery resources and to undertake programmes of work to achieve the reduction and elimination of wasteful fishing practices, wherever they may occur, especially in relation to large-scale industrialized fishing."[118]

104. To a large extent, the removal of subsidies which are considered to contribute to over capacity and overfishing would result in a reduction of capital into the sector, a reduction of fishing harvesting levels, and would facilitate the adoption or increase the effectiveness of sustainable fisheries management systems.

105. Aquaculture is also expected to play an increasingly important role in contributing to food supply, and in easing pressures on wild fish stocks. It is used for high-value stocks like salmon, rainbow trout, yellow tail, catfish and milkfish.[119] There are environmental concerns, however, which have been raised in connection with aquaculture. Some of the potentially negative environmental effects include emissions of phosphorous and nitrogen nutrients, genetic degradation of indigenous fish stocks, and destruction of coastal habitats.[120] Nevertheless, these problems present less of a threat to the environment than the depletion of marine resources caused by overfishing.

V. FORESTRY

A. Overview

106. An estimated 40 per cent of the world's total land cover (approximately 5.1 billion hectares) is classified as forests or other wooded land: this includes 3.4 billion hectares of forests, and 1.7 billion hectares of other woody vegetation (open woodlands, scrubland and brushlands, as well as areas under shifting cultivation). Temperate and boreal forests account for roughly one-half, and tropical forests account for the other half.[121]

---

[117] UNEP (1997), *The Role of Trade Policies in the Fishing Sector: Summary Report*, UNEP/WWF workshop on "The Role of Trade Policies in the Fishing Sector", Geneva.

[118] UN (1997), *Programme for the Further Implementation of Agenda 21*, (E/1997/MISC.3) text adopted at the nineteenth Special Session of the General Assembly, Geneva.

[119] FAO (1996), *The State of World Fisheries and Aquaculture*, Rome.

[120] Mangroves, for example, are important marine habitats which provide food and coastal shelter for serval fish species. The loss of mangroves as a result of various factors related to fisheries activities, such as aquaculture, continues to accelerate world wide. *See* IUCN (1996), *Biodiversity in the Sea*, Gland: IUCN.

[121] The FAO classifies forests as land with a minimum tree crown cover of 20 per cent in developed countries and 10 per cent in developing countries, with continuous forest defined as trees usually growing to more than about 7 m in height and able to produce wood. This includes both closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground, and open forest formations with a continuous grass layer in which tree cover at least 10 per cent of the ground; in the developing countries, a forest is an ecosystem with a minimum of 10 per cent crown cover of trees and/or bamboos, generally associated with wild flora, fauna and natural soil conditions, and not subject to agricultural practices. The term forest is further subdivided into two categories according to origin: natural forests are a subset of forests composed of tree species known to be indigenous to the area; plantation forests are: (a) established artificially by afforestation
(continued…)

107. The principal economic and environment problems facing the forestry sector worldwide are deforestation and forest degradation.[122] Deforestation leads to local problems, such as a deterioration in soil cover, as well as global problems, such as a reduction of carbon sinks for greenhouse gases and a loss of biodiversity. Estimating the extent of deforestation is difficult; data are often unreliable and the methodological approaches used to measure deforestation differ. Measuring the absolute rate of logging, for example, is usually unhelpful in this respect.[123] Furthermore, what constitutes sustainable forest management differs depending on the country and the type of forest under consideration, the ecosystems within forests, environmental factors, the stage of economic development of the country, demographic trends in the country, the education and cultural traditions of indigenous peoples, land tenure and other factors.[124] With these reservations in mind, however, it has been estimated that between 1990 and 1995, the net loss in standing forests worldwide was approximately 56.3 million hectares.[125]

108. In terms of global forestry production, coniferous (softwood) timber comprises 70 per cent of global demand for industrial uses, while broad-leaved (hardwood) timber accounts for the remaining one-third. The FAO identifies six categories of wood products: roundwood (industrial and fuel), sawn-wood, wood-based panels, wood pulp and paper products and fuel-wood.[126] There are also many kinds of non-wood forest products, such as gums, resins, oils, rubber, commercial botanical products, pharmaceutical products, fruits, and animals. In recent years, industrial roundwood production has grown to approximately 1.2 billion m^3, of which approximately 6-8 per cent is traded internationally.[127] In the case of wood pulp, sawn-wood, wood-based panels and paper and paperboard, 20-25 per cent are traded internationally. While wood pulp as a proportion of world trade has remained relatively constant since the 1960s, the share of sawn-wood and wood-based panels that is traded has doubled, with sawn-wood having increased from 12 to 23 per cent and wood-based panels from 12 over 25 per cent. Paper is important in value-added terms: the proportion of paper products that is traded has increased substantially, from 17 per cent in the 1970s to 25 per cent in the 1990s.[128] To date,

---

[121](…continued)
on lands which previously did not carry forest within living memory, and (b) established artificially by reforestation of land which carried forest before, and involving the replacement of the indigenous species by new and essentially different species or genetic variety. *See* FAO (1990), *Forest Resources Assessment,* Rome.

[122]For a discussion, *see* IPF (1996), *Underlying causes of deforestation and forest degradation,* (E/CN.17/IPF/1996/15). The FAO defines deforestation as changes in forests by the depletion of tree crown cover to less than 10 per cent. Forest degradation is considered to be changes within the classification of type of forest (e.g. from closed to open forests) which negatively affect a forest stand or site and lower the production capacity.

[123]*See,* for example, World Bank (1995), *Monitoring Environmental Progress,* Washington; World Resources Institute (1996), *World Resources 1996-1997,* Oxford: Oxford University Press; A. Hammond et. al. (1995), *Environmental Indicators,* Washington: World Resources Institute; E. Barbier (1994), "The Environmental Effects of Trade in the Forestry Sector", in *The Environmental Effects of Trade,* Paris: OECD; and A. Korotkov and T. Peck (1993), *Forest Resources of the Industrialized Countries: an ECE/FAO assessment,* Rome: FAO.

[124]World Bank (1995), *Monitoring Environmental Progress,* Washington.

[125]FAO (1997), *The State of the World's Forests,* Rome.

[126]Ibid.

[127]Statistics are found in FAO (1997), *Commodity Market Review,* Rome; FAO (1997), *State of the World's Forests,* Rome; UNCTAD (1996), *Implications of the Uruguay Round for Trade in Wood and Wood Products,* Geneva; and IPF (1996), *Trade and environment relating to forest goods and services* (E/CN.17/IPF/1996/22).

[128]IPF (1996), *Trade and environment relating to forest goods and services,* (E/CN.17/IPF/1996/22).

several countries have experienced at times significant wood shortages, including fuel-wood and other wood supplies.[129]

109. With respect to international trade, the global market for forest products in the 1990s was largely dominated by developed countries, in terms of both exports and imports. Trade flows in developed countries comprise approximately 85 per cent of total imports and exports across all categories of forest products, with the exception of tropical industrial roundwood.[130]

B. Trade Restrictions and Distortions

110. A number of measures affect trade in this sector, including tariffs and tariff escalation; subsidies; certification of sustainable forest management; labelling of forest products; market transparency for forest products; promotion of less-used forest species; and financing and technology to improve sustainable forest management and increase value-added processing of wood and wood products. In assessing the economic impact of various policy interventions in the forestry sector, it is important to note that government policies play a crucial role in sustainable forest management given government's extensive responsibilities in this sector, such as land use regulatory decisions, environmental and biodiversity protection as well as managing and owning forest land. Government policies also affect the rate of conversion of forests to other revenue sources, such as agricultural production or urban and industrial development.[131]

(a) Tariffs

111. While tariff peaks still remain, particularly for some products of export interest to developing countries, average trade weighted tariffs on wood and wood products are low in relative terms. The outcome of the Uruguay Round has had a number of important implications for tariffs on forest products.[132] The average trade weighted tariff applied by developed countries prior to the Uruguay Round was 3.5 per cent for imports from all sources and 4.6 per cent for imports from developing countries. Following the Uruguay Round, average trade weighted tariff rates for forest products imported by developed countries (i.e., wood-based products including wood, cork, softwood, wood pulp, wood panels, plywood and fibre board) have been reduced to 1.1 per cent for imports from all sources and 1.7 per cent for imports from developing countries.[133] Tariff-free quotas which were applied to some unprocessed or semi-processed products prior to the Uruguay Round have now been replaced by bound tariff rates, thus promoting transparency and stability for trade in these products and providing a quantifiable basis for future negotiations to eliminate tariffs. Developing countries have maintained comparatively higher tariff rates following the Uruguay Round than their developed country counterparts.

---

[129]World Resources Institute (1996), *World Resources: 1996-1997,* Oxford: Oxford University Press; and World Bank (1995), *Monitoring Environmental Progress,* Washington: World Bank.

[130]UNCTAD (1996), *Implications of the Uruguay Round for Trade in Wood and Wood Products,* Geneva.

[131]IPF (1996), *Trade and environment relating to forest goods and services,* (E/CN.17/IPF/1996/22).

[132]UNCTAD (1996), *Implications of the Uruguay Round for Trade in Wood and Wood Products,* Geneva.

[133]GATT (1994), *The Results of the Uruguay Round of Multilateral Trade Negotiations, Market Access for Goods and Services: Overview of the Results,* Geneva.

112. Estimates of the implications of the reduced tariffs differ considerably.[134] For example, the FAO has estimated that Uruguay Round tariff reductions will result in increased trade in the range of US$340 million to US$472 million per annum for selected forest products in key markets.[135] This represents a percentage change in imports of world forest products resulting from tariff reductions of approximately 0.4 per cent. A GATT Secretariat study estimated that exports of forestry products in 2005 will be in the range of 3.7 to 5.6 per cent higher than the level that would have occurred in the absence of the Uruguay Round results.[136] It has been reasoned that these large differences in estimates are attributable to the various models assigning differing degrees of importance to the economies of scale that would be reaped from the increased production following the tariff liberalization, the importance of the erosion of tariff preferences, the structure of the national and world market for forestry products and the low elasticity of demand for substitutable products.

113. In the Committee on Trade and Environment, concern has been expressed with respect to tariff escalation in the market for wood and wood products. Tariffs escalate when they are imposed at a higher level on processed and semi-processed products (e.g. manufactured wood products, furniture, paper) than on unprocessed products and raw materials (e.g. wood in the rough). For producers in the importing country, this implies advantageously low rates of duty in imported inputs relative to the final product. Their value-added (i.e. wages and returns to capital) is then rewarded to a greater extent than would be the case if a single tariff rate were applied across-the-board on all imports, irrespective of the stage of processing. That creates an incentive for resources in the importing country to move into, and increase the size of, the protected industry. It also creates a market access barrier which tends to prevent foreign suppliers who are exporting unprocessed products and raw materials from diversifying and moving into higher stages of processing, hence reducing their relative share of final value-added.

114. The GATT Secretariat has estimated that the tariff commitments undertaken as a result of the Uruguay Round represent a major step towards eliminating tariff escalation for wood and wood products.[137] Reduction in tariff escalation in the case of plywood and wood panels, an area of export importance to developing countries, could bring about environmental benefits in the import market by ending the protection of inefficient processing operations and benefit developing country exporters, both directly by increasing exports of plywood and wood panels themselves, as well as by improving domestic welfare.

---

[134] This is influenced by the fact that not all tariffs are MFN. Developing countries, for example, benefit from special tariff preferences as a result of bilateral or multilateral schemes, notably the GSP, which provide for reduced tariffs or duty-free entry of imports of wood and wood products. The GSP is a system of voluntary concessions by importing countries who specify applicable quotas for specific product categories. It should be noted that tariff preferences offered by GSP over MFN rates for wood and wood products in developed country markets will be reduced with the full implementation of the Uruguay Round commitments in 2005. Information available in the WTO Secretariat; *See* UNCTAD (1996), *Implications of the Uruguay Round for Trade in Wood and Wood Products*, Geneva; and E. Barbier (1996), *Impact of the Uruguay Round on international trade in forest products*, Rome: FAO.

[135] E. Barbier (1995), *Trade in Timber-based Forest Products and the Implications of the Uruguay Round*, Rome: FAO; and E. Barbier (1996), *Impact of the Uruguay Round on International Trade in Forest Products*, Rome: FAO.

[136] GATT (1994), *The Results of the Uruguay Round of Multilateral Trade Negotiations. Market Access for Goods and Services: overview of the results*, Geneva.

[137] GATT (1994), *The Results of the Uruguay Round of Multilateral Trade Negotiations. Market Access for Goods and Services: overview of the results*, Geneva, p. 14 and Annex II. Tariff escalation is measured by the change in the tariff wedge, that is by the change in the absolute difference between tariffs at the higher and lower stages of processing.

(b) Subsidies

115. Forests play a number of important roles apart from the revenue generation associated with logging. They are important, for example, in soil fixing, carbon sequetion and economic and non-economic considerations relating to biodiversity. Thus, the concerns relating to forestry management on the part of governments are increasingly broadening to encompass integrated land-use issues. One result is that a variety of direct and indirect subsidies are now applied in the forestry sector which have considerable direct and indirect implications for the management of forestry resources and eventually trade. Costs to help achieve sustainable forestry, for example, can be borne through forgone revenues caused by creating news parks and protected areas, and allocating forests for non-timber uses, such as recreation and biodiversity values.

116. The net effect of subsidies on forestry management is complex. Concessions on taxes and the terms of logging can constitute indirect or implicit subsidies resulting in domestic overcapacity and overproduction, the operation of inefficient mills, and the unsustainable use of standing forests. Determining stumpage is important as they frame the fee incentives structure for production and rates of deforestation.

117. Environment-related subsidies include the use of grants, tax concessions and other support schemes to promote research and development as well as implementation of sustainable forest management practices. As set out in WT/CTE/W/46, several notifications have been made which relate to forestry products. These include, the notification of information supporting the integration of environmental measures in the forestry sector, including an environmental forestry grant; measures in support of "quality forests" which included the promotion of forest-related environmental values; measures to enhance the conservation and sustainable use of forests; and more general measures to encourage the "efficient and sustainable use … of agriculture and natural resources, including lands, water, fish and forest products".[138]

(c) Non-tariff measures

118. Other non-tariff measures affecting trade in wood and wood products include tax exemptions or deferrals for producers, special export or import facilities, duty relief for forest-related equipment or subsidies applied to the development of sustainable forest production methods. While many non-tariff measures directly affect trade in wood and wood products, such as quantitative import restrictions, the effects of other measures are indirect, such as tax credits for plantation forestry and R&D assistance to the processing industry. Given the diversity of types of forest species and value-added wood products, identifying and measuring the degree of trade restrictiveness of many of these measures (i.e. by establishing a tariff equivalent of the non-tariff measure) is particularly difficult.

119. Export controls, including export taxes, restrictions and bans on certain products (e.g. unprocessed logs)[139], are also applied in some exporting countries to encourage domestic processing of tropical timber for export.[140] Reasons cited for such export measures include compensating exporters of processed products for barriers in importing countries on imports of plywood and other processed

---

[138]*See* WT/CTE/W/46.

[139]M. Gillis (1988), "Indonesia: Public Policies, Resources Management, and the Tropical Forest", in R. Repetto and M. Gillis, eds., *Public Policies and the Misuse of Forest Resources*, Cambridge: Cambridge University Press.

[140]M. Othman (1995), "Forest conservation and its effects on peninsular Malaysian log supply", *ASEAN Economic Bulletin*, Vol.11, No.3; and R. Broad (1995), "The political economy of natural resources: case studies of the Indonesian and Philippine forest sectors", *Journal of Developing Areas*, Vol. 29.

wood products. In this case the reasoning used is that log export restrictions result in a higher price of logs to processors in importing countries while reducing the cost disadvantage faced by domestic processors in the exporting countries as a result of the import barriers. Another rationale is that it is important to create value-added in the domestic processing of forest products for domestic income and employment. By gaining additional income through the value-added processing, pressure to harvest forests would be reduced. With this objective in mind, some forest exporting countries have imposed export duties levied according to the different processing stages as an incentive to build domestic value-added wood processing capacities. Some export controls have been used to encourage the conservation of various types of forests, such as old-growth forests. One suggestion of relevance in this context is for a "trade-off" to be negotiated whereby developed countries would agree to eliminate the remaining tariffs on processed wood products and developing countries would agree to eliminate log export restrictions.[141]

120. A number of trade-related environmental measures with potential implications for the sustainable management of forests and trade in wood and wood products have been notified by WTO Members. These include requirements relating directly to the recycled content of some paper products and regulations specifying types of allowable packaging materials, as well as the percentage of packaging acceptable in relation to product size or weight. Packaging reuse and recycling targets, or packaging recovery or return schemes also have been notified.

121. Certification of sustainable forest management and labelling of forest products are considered to be complementary to forest management policies; to date they have concentrated primarily on forest and forest-based products. There are an increasing array of approaches to forest certification. The ISO approach is based on an audit of a management system applied by a company to its forest management practices. The ISO 14001 EMS requires an audit of the management system against the specifications of the standard. Another approach, exemplified by the Forest Stewardship Council (FSC)[142], which is based on an audit of forests against regional standards based upon certain principles, in this case those approved by the FSC. No regional standards have yet been completed but certification and auditing by individual certifiers is proceeding. This approach tries to use chain of custody for forest products and a product label.

122. All approaches to certification and labelling are intended to support marketing efforts in markets where environmental factors may influence purchasing decisions. Studies suggest the demand for certified or labelled forest products is small and concentrated in a narrow segment of the market. Also, the actual trade impact of certification and labelling has apparently been very small.[143] The FAO notes that of greater concern than the actual trade effects of these schemes is the uncertainty which may exist for exporters concerning the role of such schemes in determining market access.[144] Initially, labelling and certification schemes concentrated on tropical forest products but have since been extended to include temperate and boreal timber products. Concerns have been raised about additional costs which certification and labelling impose, including increased auditing, assessing, identifying and monitoring management of forestry production, as well as certifying the chain of custody.

---

[141]G. Porter (1996), *An analysis and proposal for an IPF Recommendation*, Environmental and Energy Study Institute, Washington, presented to the second session of the IPF, Geneva.

[142]The FSC is a non-governmental organization created in 1993.

[143]FAO (1997), "Forest Products Certification", *Forestry Information Notes*, Rome; IPF (1996), *Trade and environment relating to forest goods and services*, (E/CN.17/IPF/1996/22); and P. Varangis, C. Primo Braga and K. Takeuchi (1993), *Tropical timber trade policies: what impact will eco-labelling have?*, Washington: World Bank.

[144]FAO (1997), "Forest Products Certification", *Forestry Information Notes*, rome.

C. Environmental Benefits

123. To a large extent, deforestation has little to do with international trade. It is primarily linked to other factors such as changing production and consumption patterns, such as expanding demand for food, land tenure patterns, expansion of subsistence agriculture and the demand for fuel-wood and charcoal to meet basic energy needs.[145] To the extent that deforestation is linked to low incomes per capita and poverty more generally, a clear case can be made that additional economic benefits to poorer countries has environmental benefits.

124. While the area of temperate forest in the world has remained broadly stable, net deforestation of the tropical rain forests has occurred at an accelerating pace.[146] Concern about depletion and degradation has focused very largely on tropical timber producing countries. Felling timber for fuel-wood is considered to be an important cause of deforestation in tropical timber producing countries. In fact, the production of charcoal and fuel wood constitutes 55 per cent of the total volume of roundwood production in developing countries; less than 0.3 per cent of this production enters world trade.[147] The felling of trees for subsistence cropping and livestock grazing is also a principal cause of deforestation of tropical forests.[148] Other measures which affect the forestry sector include agricultural subsidies which provide incentives for forestry clearing or land conversion to agricultural production and grazing.

125. While benefits flow to the environment through the removal of trade distortions and restrictions in the agricultural sector (see Section II on agriculture) there can be pressure for agricultural extension into marginal land. It could be argued that the environmental problems involved then extend beyond deforestation into the damage associated with more intensive and extensive agricultural production on converted forest land.[149]

126. These potential problems should, however, be addressed through domestic resource management policies to protect forest resources and raise the value of forest products, not by foregoing the benefits of agricultural trade liberalization. Agroforestry can be one solution, whereby a mixture of trees and agricultural crops or livestock are raised on the same piece of land and trees form an integral part of the farm.[150] In several pilot projects and other case studies, agroforestry has proved to be an effective tool for improving land use and increasing agricultural productivity. Many agroforestry extension

---

[145]IPF (1997), *Report to the fifth session of the CSD*, New York (E/CN.17/1997/12); IPF (1996), *Report of the Secretary General on the underlying causes of deforestation and forest degradation*, New York (E/CN.17/IPF/1996/15).

[146]Barbier (1994), "The Environmental Effects of Trade in the Forestry Section", in C. Runge, ed., *The Environmental Effects of Trade*, Paris: OECD.

[147]*See* T. Amelung (1991), *Tropical Deforestation and an International Economic Problems*, paper presented at the Egon-Sohmen-Foundation Conference on Economic Evolution and Environmental Concerns, Austria; S. Narendra et. al. note that although regional variations are substantial, subsistence farmers in developing countries account for more than 60 per cent of the loss of tropical forests annually. *See* S. Narendra, ed., (1992), *Managing the World Forests*, Kendall/Hunt.

[148]One estimate is that the percentage share of agriculture in deforestation as over 80 per cent for tropical forests. E. Barbier et. al. (1993), *The Economic Linkages Between the Trade in Tropical Timber and the Sustainable Management of Tropical Forests, Final Report*, Yokohama: ITTO Activity.

[149]An UNCTAD study identifies one of the main problems related to trade in wood and wood products of developing countries as being the depletion of forest resources caused in part by production destined for exports as well as for numerous other reasons such as conversion of forest lands to agricultural or urban uses. *See* UNCTAD (1996), *Implications of the Uruguay Round for Trade in Wood and Wood Products*, Geneva.

[150]For a discussion of agroforestry, *see* OECD (1995), *Forestry, Agriculture and the Environment*, Paris.

projects have successfully increased crop production by 25 to 100 per cent by using multipurpose trees to arrest soil erosion, enhance soil fertility, and provide a favourable microclimate for crops and livestock.[151] Agroforestry, like plantations, has certain limitations as regards providing suitable habitat for conservation of biological diversity.

127. Other governmental measures relevant to forest products include standards and regulations for sanitary and phytosanitary reasons, the protection of flora and fauna, or the protection of human health. Border controls are imposed to control, for example, the import of certain harmful pests or plant or tree species diseases. Measures include quarantine or import prohibitions of certain types of wood and wood products. One example is the restriction in some countries on the import of wood panels which have been produced with formaldehyde glue, because of the risk to human health. Regulations have also been introduced banning certain processes and materials such as chlorine, which produces toxic by-products. Determining the potential trade restrictiveness of such measures is difficult, and its has been suggested that with a sufficient level of transparency such measures may not necessarily have negative effects on market access.[152] An SPS notification on plant protection regulations to protect the agricultural and forestry sectors included as its objective "protection of the environment".[153]

128. In spite of the relatively minor share of trade in total world production of forestry products, the contribution which the removal of trade restrictions and distortions can make to world deforestation and forest degradation is still important. The link between trade and the loss and degradation of global forests is an issue which has been discussed in various international fora, including the ITTO, the UNCED and the IPF.[154] In this context, the results of the Uruguay Round in improving market access for forest products by significantly reducing tariffs have been noted as a positive contribution to enhancing sustainable forest management.[155]

129. The removal of certain types of agricultural subsidies, in particular land-clearing subsidies, may alleviate pressures to clear forest for agricultural purposes. Similarly, potential environmental benefits may flow from removing quantitative restrictions or similar measures limiting exports. Export taxes and restrictions on unprocessed timber are used by some timber-exporting countries to encourage forest-based industrialization. These are reinforced in certain cases by other measures giving preferential treatment to domestic processing industries, such as supplying raw materials to local producers at lower than world market prices. In certain cases they may be viewed as a means of compensating domestic processors for tariff escalation and other barriers faced in export markets. Some results of using trade restrictions, such as export bans on logs, as a tool for encouraging higher value-added exports and conserving scarce forestry resources have been discouraging.[156] However, in situations where sustainable forest management policies include improved land use objectives to achieve a wider range of benefits from forestry, measures to increase the value-added processing from timber can decrease pressure to harvest larger volumes.

---

[151]*See* CIDA (1997), *Tropical Forestry and the Environment*, Ottawa: Canadian International Development Agency.

[152]IPF (1996), *Trade and environment relating to forest goods and services*, (E/CN.17/IPF/1996/22).

[153]*See* WT/CTE/W/46.

[154]At the UNCED Governments adopted a chapter on forests in *Agenda 21*, and a set of "Forest Principles" which, *inter alia*, deals with the relationship between trade and sustainable forest management.

[155]IPF (1996), *Trade and environment relating to forest goods and services*, (E/CN.17/IPF/1996/22).

[156]UNCTAD (1995), *Trade, environment and development lessons from empirical studies: the case of the Philippines*, Geneva.

130. The loss and degradation of the world's forests is the subject of ongoing discussions at the national level and in various international fora. Work of relevance to the CTE's discussion under this Item was initiated in the context of the UNCED, where agreement was reached on "Non-legally binding authoritative statement of principles for a global consensus on the management, conservation and sustainable development of all types of forests" (the "forest principles"). (Principles 13 and 14 are particularly noteworthy).[157] As well, several Chapters of Agenda 21 on deforestation, land-use and biodiversity are relevant to issues raised by sustainable forest management. To follow-up on the UNCED, an *Ad Hoc* Intergovernmental Panel on Forests was established by the UN Commission on Sustainable Development (CSD) to "examine relevant factors affecting trade in forest products and other forest and trade issues in an integrated and holistic approach that promotes a supportive relationship between trade and environment". Extensive work is underway in other fora (e.g. FAO, ITTO, and the Climate Change and Biological Diversity Conventions) of relevance to forest-related issues and with respect to providing positive incentives for sustainable forest management and conservation.[158] The UNGASS, in June 1997, adopted the IPF's numerous recommendations on the conservation and use of forest resources. Several proposals for action trade and environment were made, including "to examine the possibility of further initiatives on trade liberalization within the auspices of the WTO".[159] The UNGASS established, an *Ad Hoc*, open-ended Intergovernmental Forum on Forests to work towards multilateral consensus on the sustainable development of all types of forests, including the option of a forest convention.[160] The Forum will report on its work to the CSD in 1999.

VI. NON-FERROUS METALS

A. Overview

131. The non-ferrous metals sector is comprised of several primary metals, the most important of which are aluminium, copper, nickel, zinc, lead, tin, and precious metals (gold, silver and platinum). The principal economic activities in the sector include mining, processing and production of semi-fabricated metal products, such as metal sheets, rods and bars. Semi-fabricated metal products are processed from primary and secondary (recycled) metals and used in the manufacturing of industrial and consumer products.

---

[157] *Principle 13 of the Forest Principles*: (a) Trade in forest products should be based on non-discrimination and multilaterally agreed rules and procedures consistent with international trade law and practices. In this context, open and free international trade in forest products should be facilitated; (b) Reduction or removal of tariff barriers and impediments to the provision of better market access and better prices for higher value-added forest products and their local processing should be encouraged to enable producer countries to better conserve and manage their renewable forest resources; (c) Incorporation of environmental costs and benefits into market forces and mechanisms, in order to achieve forest conservation and sustainable development, should be encouraged both domestically and internationally; (d) Forest conservation and sustainable development policies should be integrated with economic, trade and other relevant policies; and (e) Fiscal, trade, industrial, transportation and other policies and practices that may lead to forest degradation should be avoided. Adequate policies, aimed at management, conservation and sustainable development of forests, including where appropriate, incentives, should be encouraged; and *Principle 14*: Unilateral measures, incompatible with international obligations or agreement, to restrict and/or ban international trade in timber or other forest products should be removed or avoided, in order to attain long-term sustainable forest management.

[158] IPF (1996), *Trade and environment relating to forest goods and services*, (E/CN.17/IPF/1996/22).

[159] *See* the recommendations for action in the Report of the Secretary General (1997), *Chapter on Trade and environment relating to forest goods and services*, adopted at UNGASS; and WT/CTE/W/48 which provides an update of the activities of the IPF, including excerpts of relevant decisions reached at its session in February 1997.

[160] The *Ad Hoc*, open-ended Intergovernmental Forum on Forest was established under the aegis of the UN Commission on Sustainable Development by the UNGASS with a three-fold mandate to: (i) promote and facilitate the implementation of the IPFs proposals for action; (ii) review, monitor, and report on progress in the management, conservation and sustainable development of all types of forests; and (iii) consider matters left pending on the programme elements of the IPF, in particular trade and environment in relation to forest products and services, transfer of technology and the need for financial resources. The Forum should also identify the possible elements of and work towards consensus for international arrangements and mechanisms, for example a legally binding instrument.

132. World production and consumption of primary non-ferrous metals has grown continuously over the course of the past several decades.[161] Rising waste disposal costs, in particular in OECD countries, and the growing importance of developing countries in global non-ferrous metal consumption have gradually encouraged recovery and recycling of non-ferrous metals, which now meets about 40 to 50 per cent of global demand for most metals. Developing countries account for the bulk of world exports of many non-ferrous metals, including bauxite (four-fifths) and copper (one half) and their share of the total production of primary metals has been increasing. The share of developing countries in mining several non-ferrous metals has been steadily increasing. This trend is expected to continue as most new mines and unexplored regions which are potentially rich in metals are located in developing countries. Trade flows in primary metals and finished products show that, despite the recent increase in their share, developing countries account for a small share of total world consumption. However, it is projected that the majority of the increase in consumption over the next decade will come from developing countries.[162]

133. World trade in non-ferrous metals in 1995 was US$100 billion (see Appendix Table 1). On a regional basis, the largest exporters were Western Europe (US$ 38 billion), Asia (US$17 billion) and North America (US$15 billion). Intra-trade in Europe was significant (US$29 billion) and imports into the Asian region were US$29 billion and those into North America were US$17 billion.

134. Given the diverse characteristics of the various metals within the non-ferrous metals sector, aluminium and copper, as the key non-ferrous metals, are discussed below.

B. Trade Restrictions and Distortions

135. Tariffs applied by developed countries on metal ores and concentrates, and unrefined and refined metals were already low prior to the Uruguay Round and have been further reduced. Uruguay Round tariff commitments for bauxite and aluminium were generally minimal and are estimated to be unlikely in themselves to lead to major changes in trade patterns. Post-Uruguay Round tariff rates for copper from the mining to semi-fabricated stage have remained either unchanged at low levels or have been reduced marginally. In the case of tin, tariff concessions were significant; tin is now the only fully liberalized base metal in the world's three largest import markets (EC, Japan and US). Although the experience differs between metals, there is still evidence of higher average tariffs on finished products (4.1 per cent) than raw materials (0.1 per cent) for non-ferrous metals imported into developed countries. In fact, tariff escalation for lead and zinc is estimated to have increased in certain major developed country markets.[163]

136. It should be noted that factors other than tariffs play a predominant role in shaping market access in the non-ferrous metals sector. These include the availability of high-grade deposits and access to the financial resources needed to develop projects, economies of scale, energy prices, access to

[161]Data in this section has been collected from *World Metal Statistics 1997*, World Bureau of Metal Statistics; UNCTAD (1996), *The Uruguay Round and the World Copper Market*, (UNCTAD/COM/78); UNCTAD (1996), *Bauxite, Alumina and Aluminium and the Uruguay Round*, (UNCTAD/COM/79); UNCTAD Commodity Yearbook; and the *Annual Non-Ferrous Metals 1996*, American Bureau of Metals Statistics.

[162]UNCTAD (1995), *Analysis of the evolution of prices and trade of commodities to be expected in the light of the results of the Uruguay Round, with particular emphasis in their implications for developing countries, including their diversification prospects*, Geneva.

[163]GATT (1994), *The Results of the Uruguay Round*; and UNCTAD (1995), *Analysis of the evolution of prices and trade of commodities to be expected in the light of the results of the Uruguay Round, with particular emphasis in their implications for developing countries, including their diversification prospects*, Geneva.

technology, proximity to the market for semi-fabricates, land technological change and developments relating to new materials, substitution re-use and recycling.[164]

137. Subsidies in the non-ferrous metals sector are generally applied to inputs in the production process of a metal. Production-related subsidies primarily include subsidies on energy inputs. Energy costs represent the largest single cost in smelting and refining operations for aluminium and copper. The effect of energy subsidies is to decrease the price of energy inputs, which contributes to higher energy usage and energy-inefficient production methods. Other examples of indirect production subsidies are subsidized freshwater inputs for certain mining and refining processes which require large freshwater inputs; mining rights on government as compared to private owned lands; and transport subsidies.

138. The elimination of price distorting subsidies can lead in general to a more efficient use of energy and act as an incentive to adopt more energy-efficient smelting and processing technologies. However, as in other sectors, a difficult policy balance exists between removing economically inefficient energy subsidies, while maintaining or increasing incentives to promote the adoption of environmentally-efficient technologies or methods which enhance environmental performance.

(a) Aluminium

139. The aluminium sector is the second most important sector in international metal trade after ferrous (steel) metals.[165] There are three stages in the production of primary aluminium: mining of bauxite; processing of bauxite into alumina, and processing of alumina into primary aluminium. The aluminium smelting industry is engaged in the production of primary aluminium by the electrolysis of molten alumina, which is extracted by refining bauxite ore (approximately 4.5 tonnes of bauxite yield 2 tonnes of alumina, which in turn provide 1 tonne of aluminium). The industry is also engaged in the production of secondary aluminium from recycled industrial and consumer aluminium products. The aluminium is then processed into billets and ingots of various sizes to be used in the manufacture of extruded or laminated products or remelted for casting into other forms by the semi-fabricated metal product industry.

140. Semi-fabricated products are then produced from unwrought aluminium (primary or secondary metal) through rolling, extruding or other processes (e.g. bars, rods, wire, sheets, strips, tubes, pipes and fittings).[166] Given the fact that production of primary aluminum is an energy intensive process, one of the key factors in its production is access to energy.

141. Primary aluminium and semi-fabricated aluminium industry do not have the same characteristics. The primary aluminium industry operates world scale plants; the primary locational factor is access to competitively priced energy. The semi-fabricated aluminium industry tends to operate plants close to a major market, since the primary locational factor is shipping costs.

---

[164]*See* UNCTAD (1995), *Analysis of the evolution of prices and trade of commodities to be expected in the light of the results of the Uruguay Round, with particular emphasis in their implications for developing countries, including their diversification prospects,* Geneva.

[165]Data from UNCTAD (1996), *Bauxite, Alumina and aluminium and the Uruguay Round*, UNCTAD/COM/79.

[166]See UNCTAD (1995), *Analysis of the evolution of prices and trade of commodities to be expected in the light of the results of the Uruguay Round, with particular emphasis in their implications for developing countries, including their diversification prospects,* Geneva.

142. Approximately 30 per cent of world bauxite production is traded.[167] Bauxite has increasingly been refined to alumina before export, since transportation constitutes a major part of the cost of bauxite. Developing countries' share of world bauxite exports increased from 72.1 per cent in 1972-74 to 81.8 per cent in 1992-1994.

143. Approximately one-half of world alumina production enters international trade. The share of developed countries' trade has risen from 53 to 64 per cent, mainly because of increased exports from Australia (which accounts for 44 per cent of total trade). The share of imports continues to grow in several countries, including Brazil, Egypt and Indonesia.

144. Primary aluminium is produced through an energy-intensive smelting process. As with alumina, approximately 50 per cent of world primary aluminium production is traded. The share of developing countries increased significantly from 10 to 27 per cent from the period 1972-74 to 1992-94.

145. Semi-fabricated products are produced from unwrought aluminium (primary or recycled scrap metal). About a quarter of world production of semi-fabricated products is traded and this proportion is increasing rapidly. Developed countries account for the bulk of international trade in semi-fabricated aluminium (accounting for 72 per cent of world imports and 87 per cent of world exports in 1992-1994). Developing countries' imports of semi-fabricated products are increasing (25.4 percent of imports and 10 per cent of exports in 1992-94).

146. Tariff commitments for bauxite, alumina and aluminium in the Uruguay Round were generally small and an UNCTAD assessment concludes that they are unlikely in themselves to lead to major changes in trade patters. Of the countries with significant trade in the products concerned, a number made offers with higher rates than they already applied. Tariff escalation has diminished marginally. Erosion of preferences is relatively unimportant, given the small concessions, but this could be significant for severe countries if a principal importer were to eliminate its 6 per cent tariff on primary aluminium.[168]

(b) Copper

147. Copper is the third most important sector in international metal trade.[169] Copper production follows several stages from mining of ores and processing to concentrates, to unrefined copper, to refined copper, to the production of semi-fabricated copper and copper alloy products. Refined copper is basically consumed by semi-fabricating mills that transform unwrought refined copper into semi-fabricated products such as wire, plates, sheets, tubes, bars, rods, tubes and pipe fittings. These products are made either of pure copper or of alloys of copper and other metals, like zinc, tin, and nickel. Thus, the bulk of refined copper consumption consists of the input to such semi-fabricating mills.

148. World copper consumption has steadily increased in recent decades, from 9.5 million tonnes in 1982 to approximately 13 million tonnes of refined copper in 1995. This trend in worldwide consumption is expected to continue, with developing countries expected to account for the bulk of the increase as demand for infrastructure works, such as power generation and transmission, communication, transportation and building materials, continues to increase.

---

[167]The main bauxite producers are Australia, Guinea, Jamaica, Brazil, China, Venezuela and India. The principal bauxite exporters are Guinea, Brazil, Australia and Jamaica.

[168]Data from UNCTAD (1996), *Bauxite, Alumina and Aluminium and the Uruguay Round*, UNCTAD/COM/79.

[169]UNCTAD (1996), *The Uruguay Round and the World Copper Market*, UNCTAD/COM/78.

149. World mined copper production grew from 8 million tonnes in 1982 to over 10 million tonnes in 1995. The difference between consumption and production is supplied by secondary or recycled copper. In industrialized countries in particular, market share of recycled copper currently exceeds 40 per cent. Copper loses none of its physical or chemical characteristics through repeated recycling; recycled copper requires only 5 per cent of the energy of the copper ore to be converted to refined copper.[170]

150. There are no tariffs imposed by the main copper importers on copper concentrates and quotas or non-tariff measures are applied to copper concentrates in any major market. Several countries (e.g. Brazil and Korea) apply very low tariff rates of approximately 1 per cent. Import duties on unrefined copper will generally be reduced as a result of the commitments undertaken during the Uruguay Round.

151. The bulk (62 per cent) of international trade in unwrought copper is carried out in refined metal form. The share of world refined production that enters trade is 50 per cent. Tariffs on refined copper differ from market to market. For example, the EU imposes a uniform zero tariff with no other restrictions and the US imposes a tariff rate of 1 per cent.[171] Some importers maintain relatively high bound tariffs, including for example Thailand (20 per cent), and Korea and Brazil (10 per cent each).

152. Production of semi-fabricated products is highly concentrated in developed countries, although production has rapidly expanded in some Asia Pacific countries in the last two decades. The ratio of semi-fabricated products traded is much lower than either copper concentrates or refined copper. A few countries with major mining and smelting operations have extensive production facilities (US, Canada, and China). A notable feature of this sector is that no major copper producers are among the major exporters of semi-fabricates, although Chile and Australia have achieved some success in the last decade and currently account for 3 per cent of the world market share. As noted for the semi-fabricated aluminium industry, the semi-fabricated copper industry tends to operate close to a major market to minimize shipping costs.

153. UNCTAD studies on the extent and patterns of international trade in metal scrap and residues have illustrated that the bulk of OECD shipments of such materials to developing countries, and the overwhelming part of trade among developing countries, centred on a few countries in East, Southeast and South Asia. These trade patterns are the result of economic expansion in these countries combined with a material intensive growth pattern. Industrial and infrastructral development are fuelling the demand for non-ferrous secondary metals.[172]

C. Environmental benefits

154. From an environmental perspective, the effects of extraction of metals (mining) and their processing (smelting) are of particular concern. Mining activities have potential impacts on the local and global environment.[173] For example, open-pit mining can result in land degradation, and contribute to desertification and deforestation, if not properly reclaimed and rehabilitated. Mining wastes account

---

[170]M. Henstock (1996), *The recycling of Non-Ferrous Metals*, Ottawa: International Council on Metals and the Environment.

[171]UNCTAD (1996), *The Uruguay Round and the World Copper Market*, (UNCTAD/COM/78).

[172]U. Hoffman (1997), *Socio-economic aspects of recycling, particularly in the fast-growing developing countries of Asia, Mimeo*, Trade, Environment and Development Section, UNCTAD.

[173]Mining activities are categorized as either surface or underground. Surface mining includes open pit, open cast, quarry, strip, dredging and hydraulic methods. Underground mining methods include pillar-and-stope, shrinkage stope, block caving and longwall mining.

for the bulk of globally generated solid waste. The process of smelting is highly energy intensive, and often involves high levels of sulphur dioxide emissions, which are considered to contribute to global warming.

155. The degree and extent of the environmental impacts depend on local conditions and extend from exploration, extraction and processing of the ores (cleaning, screening and crushing) through to post-closure problems with abandoned mines.[174] Environmental impacts also vary depending on the metals and processes involved. One of the elements discussed a recent International Council on Metals and Environment (ICME) workshop to ensure sustainable use of non-ferrous metals was the importance of risk assessment and management related to non-ferrous metals in their extraction, production, use, recycling and disposal. The preservation of eco-systems, including the protection of forest resources, agricultural land, habitat and marine life, is also an important consideration in an assessment of the environmental effects of mining.[175] As is illustrated by case studies on environmental policies and management in the non-ferrous metals sector, the extent of the environmental effects of the mining and production of metals needs to be considered in the context of domestic environmental management.[176]

156. Therefore, the environmental effects of removing trade-related distorting policies need to be assessed on a case-by-case basis. Environmental benefits associated with trade policy reform in the primary metals sectors will accrue both to the primary mining sector itself, and to industries using metals as inputs. Benefits resulting from the following areas can be identified: (a) subsidies removal; (b) tariff elimination and reduction of tariff escalation; and (c) development of trade in recycled metals. In addition, significant environmental benefits will result from the adoption of more environmentally-sound process and production technologies.

157. Production subsidies in general, and energy and freshwater subsidies in particular, contribute to numerous environmental problems which result from mining and smelting non-ferrous metals. However, energy requirements and sources vary widely among different categories of metals production and between countries. In the case of energy subsidies (discussed in Section III of this Note), studies have demonstrated that energy underpricing which results from subsidization of energy inputs contributes to environmental problems. These include a deterioration in air quality which is linked to air pollution emissions such as sulphur dioxide, nitrogen oxides, particulate matter, and greenhouse gases. Certain types of air pollution have also been linked to soil and other types of acidification (which can for example create significant economic impacts in other sectors, such as forestry and agriculture). The impact of subsidies may be to sustain the use of inefficient and environmentally-unfriendly mining and smelting facilities.

158. Energy use in processing aluminium and copper, as well as other non-ferrous metals, is an important factor which needs to be considered when assessing the environmental effects in the sector. The variable costs of aluminium and copper smelters are a function not only of the technology used,

---

[174]*See* the case studies on various aspects of environmental problems associated with mining in the proceedings of an UNCTAD symposium (1994), *The impact of mining on the environment: problems and solutions*, Rotterdam: Balkema.

[175]*See* International Council on Metals and the Environment (ICME) (1997), "Reforesting mine sites in Brazil", *ICME Newsletter*, Vol. 5, No.1.

[176]UNEP and ICME (1996), *Case studies illustrating environmental practices in mining and metallurgical processes*. Also *see*, for example, G. Volpi (1997), *Managing trade policies for sustainable development: towards a framework for assessing the environmental impact of trade liberalisation: the case study of the mining sector in Chile*, forthcoming UNEP publication; UNCTAD (1994), *Environmental aspects of bauxite and aluminium production in Indonesia*; UNCTAD (1995), *Environmental aspects of bauxite, alumina and aluminium production in Brazil*; UNCTAD (1995), *Natural resources management and sustainable development: the case of the gold sector in Ghana*; UNCTAD (1994), *Environmental legislation for the mining and metals industries in Asia*.

but also variables such as the price of the main inputs, including energy and alumina or copper. Ore processing requires the physical separation of minerals from waste and the chemical separation of the metal from associated elements, such as sulphur and oxygen. These processes are energy-intensive. Secondary metals are already in their metallic form and generally require a much lower energy input to be transformed into semi-fabricated products. For example, primary copper which typically requires about 140 gigajoules per tonne for mining and refining processes, while secondary copper may use as little as 5 gigajoules per tonne to collect and remelt.[177] One source, for example, has calculated the figures with respect to the volume of energy required to convert primary as compared with secondary (scrap) aluminium.[178] The electrical energy equivalent of mining, smelting and refining bauxite, processing bauxite into alumina and processing alumina into primary aluminium is 50.7 kilowatt hours per kilogram of primary aluminium.[179] Of this amount, the consumption of energy required to process alumina into primary aluminium is about 18.6 kilowatt hours per kilogram. Although the recycling of secondary metals provides an opportunity to take advantage of a significant energy saving, scrap metal is not necessarily pure and therefore cannot be used in the production of all semi-fabricated metal products.

159. In addition, there are environmental effects associated with metal transport and use as well as waste management and disposal.[180] Some of the chemicals used in ore processing (such as cyanide, mercury and strong acids) are considered to be hazardous and their handling, use, storage and disposal may have important environmental effects. Most non-ferrous metal scrap is not hazardous. To the extent it is considered hazardous, and is traded, however, it would be covered by the Basel Convention on the Transboundary Movement of Hazardous Waste.

160. Awareness of the need to better manage non-renewable resources and limit waste in the metals sector has encouraged the development of and trade in recycled/secondary metals. The proportion of secondary refined metals has been increasing rapidly in response to the potential environmental and economic benefits of collecting and reusing discarded metal materials.[181] This is an important development as the global demand for semi-fabricated and fabricated industrial metal products is expected to continue expanding. Recycling has the potential to be an environmentally preferable, energy efficient manner in which to use non-renewable metal resources.[182] It needs to be borne in mind, however, that some primary material will always be required as some metal gets lost in dissipative uses.

161. An increase in semi-finished or finished output production should in theory imply that short-term environmental costs associated with increased production will be outweighed by environmental benefits associated with higher value added. This would depend on many factors outside the scope of this Note, including choice of technologies, market proximity and transport-related pollution, as well as the individual ecological conditions in the location of the expanding processing.

---

[177]M. Campbell (1996), *Non-ferrous metals recycling: a complement to primary metals production*, Ottawa: ICME.

[178]Industry Canada (1997).

[179]Electrical energy equivalent includes the volume of energy of whatever form (fossil fuel, electricity) used in the mining, smelting, processing, transportation, etc., converted into electricity equivalent.

[180]*See* World Bank (1997), *Environmental Assessment of Mining Projects*, Washington: World Bank.

[181]For example, the amount of recycled lead and copper in the final consumption has risen to 50 per cent in the United States.

[182]*See* M. Campbell (1996), *Non-ferrous metals recycling: a complement to primary metals production*, Ottawa: ICME; and M. Henstock (1996), *The recycling of non-ferrous metals*, Ottawa: ICME

162. Several sources cite the importance of the expanding use of environmentally-sound and economically efficient process technologies in the non-ferrous metals sector. For example, the use of oxygen flash technology is considered to be a more energy efficient and environmentally-sound method of smelting copper.[183] The rapidity of the adoption of environmentally-efficient technologies depends on several factors, including in some instances privatization of mines, or the incentive, in place for mining industries to invest in more efficient and environmentally-sound technologies.

VII. TEXTILES AND CLOTHING

A. Overview[184]

163. The textiles and clothing sector can be divided into four stages of production: (a) the production of natural and synthetic fibres: natural fibres include cotton and wool and various vegetable fibres, and synthetic or man-made fibres include nylon, polyester, polypropylene and acrylic; (b) yarn making or spinning; (c) fabric making, including weaving, knitting and non-woven processing; and (d) the production of end products, comprising household and industrial textile products and clothing. The various stages of production, along with differences in production processes and technology used within stages create a variety of environmental externalities of varying magnitude.

World Trade in Textiles and Clothing
(US$ billion)

	1985	1988	1990	1993	1996
Textiles	56	85	105	113	150
% change		+ 52	+ 24	+ 8	+ 33
Clothing	49	86	108	129	163
% change		+ 76	+ 26	+ 19	+ 26

Source: WTO (1996), *Annual Report*, Vol. II, and forthcoming WTO (1997) *Annual Report.*

164. Seven of the top ten textile exporters and seven of the top ten textile importers are industrial countries. The situation is basically similar in clothing exports where five of the top ten are industrial countries; however, in clothing imports, all of the top ten are industrial countries.

165. World trade flows in textiles and clothing for 1996 are presented on a regional basis in the Appendix Table. It can be seen that almost one third of textiles and clothing trade is intra-Western Europe trade. In textiles, the second largest regional flow is the rapidly growing intra-Asia trade; exports from Asia accounted for 43 per cent of world textiles and clothing trade. In clothing trade, almost 40 per cent of the 1996 value of Asian exports was accounted for by exports to North America.

166. While world trade in textiles and clothing has kept pace with world merchandise trade generally (8 per cent per annum 1990-95), in 1996 textile trade growth was zero. This, however, is considered to be a cyclical rather than a structural shift. The rates of growth for textiles and apparel exports and

[183]The first smelter based on flash smelting technology was constructed in Finland in 1949. *See* ICME (1997), "Outokumpu's Harjavalta Smelter", *ICME Newsletter*, Vol.5, No.2.

[184]Data based on R. Verret (1996), "Competitiveness: The International Challenge", in *The Challenge of Globalization: Textiles in a New Trading Environment, International Textile Manufacturing*, Vol. 16, Zürich: International Textile Manufacturers Federation.

world merchandise exports are substantially greater than world merchandise production which registered just 1 per cent average annual growth from 1990-1995. Between 1985 and 1995, textiles trade grew by 167 per cent, while clothing trade advanced 232 per cent. There has also been a shift in world trading patterns, particularly favouring a number of Asian countries. Intra-Asian trade increased rapidly over the period from 1990-95; 15 per cent per annum on average in the case of textiles and 18 per cent in the case of clothing. By contrast, intra-Western Europe trade during the same period increased on average by only 2 percent per annum for textiles and clothing.[185] In addition, exports from Eastern Europe (primarily to Western Europe) and Latin America (primarily to the United States) have undergone rapid increases in recent years.[186] For several developing countries, the share of textile and clothing production in total domestic manufacturing output has reached as high as 50 per cent.

167. Changing trade patterns reflect the fact that the textiles and clothing sector has undergone significant structural changes since the 1960s. Many industrialized countries have experienced a substantial contraction in clothing production and major restructuration and adjustment in textiles production. In some areas, such as capital and technology-intensive primary textile production (for example synthetic filament-based fibre and yarn production) as well as certain product niches (for example, high quality end of niche markets), production has continued to grow.

168. Since the production of textiles and clothing has traditionally been one of the first stages in the process of industrialization, almost all countries have some form of domestic production capacity. One way or another, these countries are affected by intensified international competition, which has been characterised by changes in capital and labour intensity in the production process and, in some instances, rapid technological innovation. This has been particularly pronounced in textiles production (such as the integration of spinning and weaving, rotor spinning and shuttleless looms in synthetic fibre production, the use of computer-aided design in textile patterns, production automation), the introduction of a pre-assembly phase in garments production, underlying changes in product composition, transport costs and marketing. It has been noted that competitive advantage increasingly is based on factors such as quality, flexibility in production processes, and the ability to respond to changes in consumer tastes.

169. Although market structures differ among and within countries, as well as according to the size of individual enterprises, some underlying patterns can be identified. One of the principal recent developments in textile production has been the automation of many production processes, energy conservation, recycling of chemicals and waste water, and a reduction in the length of the production cycle.[187] The possibility to introduce new environmentally-friendly techniques is an important consideration in what follows. Many developing country textile producers are small and medium-sized enterprises (SMEs), and some studies suggest that in general, SMEs may face difficulties in complying with environmental standards and regulations in their export markets because of insufficient access to inputs, information, technology, finance, and lack of infrastructure.[188]

---

[185]Commonwealth of Australia (1997), *Patterns of Textile, Clothing and Footwear Trade within APEC, 1990-1994*, Melbourne.

[186]However, levels in Eastern Europe and Latin America remain low compared to Asia.

[187]*See* R. Pepper and H. Bhattacharya (1994), "Changing Trends in Global Textile Technology", in *Managing Restructuring in the Textiles and Garments Subsector: An Overview*, Washington: World Bank.

[188]UNCTAD (1995), *Environment, International Competitiveness and Development: Lessons from Empirical Studies*, TD/B/WG.6/10.

B. Trade Restrictions and Distortions

170. The textiles and clothing sector has for many years been heavily influenced by numerous trade restrictions and distortions. These include export restraint measures under the former Multi Fibre Arrangement (MFA) which have been carried over into the Agreement on Textiles and Clothing (ATC) and which are to phased out over 10 years (1995-2005). There are also high tariffs, import licensing requirements, import prohibitions, and indirect subsidies on some production inputs. An extensive body of literature exists on the economic effects of these distortions; the cost of protection has been estimated on numerous occasions to be particularly high.[189]

(a) Multifibre Arrangement

171. The Multifibre Arrangement (MFA) entered into force in 1974 and extended the coverage of the restrictions on textiles and clothing from cotton products to include wool and man-made fibre products (and from 1986, certain vegetable fibre products and silk blends). Operationally, the MFA provided rules for export restraint arrangements, either through bilateral agreements or unilateral actions, when surges of imports caused market disruption or the threat thereof in importing countries.

172. It is not possible to give a definite answer as to the extent to which MFA restrictions limited trade, or what trade levels (or the structure of production worldwide) would have been in its absence.[190] An important part of world trade in these products was not restricted at all - such as trade between developed countries. Furthermore, where trade was restricted, far from all textile and clothing products being traded were covered by each MFA bilateral agreement; some MFA quotas were not fully utilized; and a number of restrictions in international trade in this sector existed outside of the MFA. The possible effect of relatively high tariffs (see below), for example, would also have to be taken into account. Nevertheless, some of the side-effects of the MFA regime are evident and are relevant for any discussion of the environment.

173. The MFA has, for example, affected the structure of world trade and production and the relative intensity of the use of both capital and labour.[191] A pattern of the shifting of production facilities has occurred from the more-restricted countries to the less-restricted or unrestricted ones; the continued expansion of new exporting areas has served to expand global production capacity. While sustaining the performance of the original, predominant suppliers, this shifting production and export pattern has stimulated the growth of industries in countries which, had it not been for the MFA quota system, would not have entered the international market as exporters when they did. Because of the protection afforded by the MFA, heavy investments by developed countries in automated equipment has been undertaken, particularly in the textiles sector. As a result, textile industries in the developed nations have become one of the most capital intensive areas within the manufacturing sector. Similarly developing countries subject to quantitative restrictions have progressively upgraded the quality of their

---

[189] *See* R. Pepper and H. Bhattacharya (1994), "Changing Trends in Global Textile Technology", in *Managing Restructuring in the Textiles and Garments Subsector: An Overview*, Washington: World Bank.

[190] Navaretti, Giorgio Barba et. al. (1995), *Overview in Beyond the Multifibre Arrangement: Third World Competition and Restructuring Europe's Textile Industry*, OECD, Paris; United States (1995) Annual Report - *Monitoring and Enforcement Activities*, http://www.ustr.gov/reports/tpa/1996; *Oxfam Policy Briefing*, http://www.oneworld.org/oxfam/policy/papers.

[191] According to Raffaelli, the effects of the MFA on exporting countries include: the limitation of competitive exports; the disruption of individual lines of production; transference of resources to less efficient lines of production; discouragement and/or distortion of investment; switch to less sophisticated products to different, more sophisticated products; improvement in products; transference of production to third countries; fight for guaranteed share of the market; quota ownership and attendant problems; costs and quota management; and political costs. *See* Marcelo Raffaelli (1994), "Some Considerations on the Multi-Fibre Arrangement: Past, Present and Future", in Meyanathan, *Managing Restructuring in the Textile and Garment Subsector*, Washington: World Bank.

textile and clothing exports in order to maximize their economic gains. In short, the thesis outlined in the introductory section of this Note where a world market free of trade restrictions and distortions would allocate resources to their most efficient uses and in accordance with consumer preferences is the antithesis of the past experience of world trade in clothing and textiles.

174. There have been various responses by developing countries to quota restrictions under the MFA. Although difficult to generalize, these include the diversification of markets and products, so as to increase the quality and technology intensity and maximize the return on investment per unit of textiles or clothing outputs traded. While many developing country producers have responded efficiently to quota restrictions, it has been noted that some producers are constrained by various domestic structural weaknesses, such as obsolete equipment and inadequate access to marketing information. What is clear is that the phase-out of the MFA is expected to result in an increase in export revenues, in particular for developing countries.[192]

(b) The Agreement on Textiles and Clothing

175. A decade of transition for the global textiles and apparel trade industry began on 1 January 1995 with the entry into force of the Agreement on Textiles and Clothing. Over a ten-year period the extensive network of bilateral quotas built up over more than three decades of special, discriminatory rules in this sector, and under which a large portion of textile and apparel exports from developing countries has been subject to restriction in the main industrial countries, will be progressively dismantled. Products which remain under quota during the transitional process are being progressively liberalized through increases in the annual growth rates at the outset and at each subsequent stage.[193] Concurrent with the removal of bilateral quotas, tariffs are also being reduced through tariff reduction commitments undertaken by WTO Members; other forms of non-tariff barriers to trade not permitted under WTO rules are also to be removed.

176. The improved access to markets globally will bring the greatest benefits to the most dynamic traders. But it will also pose challenges for companies attempting to respond to the changing global structure, requiring them to redefine their competitive strategies *vis-à-vis* old and new competitors, and to formulate appropriate investment, product and marketing strategies. Changes in cost structure, technology, innovation, marketing techniques, customers' and suppliers' strategies including those directed to adopting environmentally-friendly policies, may also be decisive factors.

(c) Tariffs

177. Post-Uruguay Round tariffs on clothing and textile trade are high world-wide, and for many countries the highest among all major industrial products.[194] Average tariffs on imported textiles and clothing products in developed countries will be 12.1 per cent with the introduction of the Uruguay Round commitments. The average for all industrial products is 3.8 per cent. In the Uruguay Round, these average tariffs were reduced by 22 per cent (from 15.5 per cent) while the industrial average

---

[192]*See* for example C. Hamilton (1990), *Textiles Trade and the Developing Countries: Eliminating the Multi-Fibre Arrangement in the 1990s*, Washington: World Bank; N. Kirmani et. al. (1984), *Effects of Increased Market Access on Exports of Developing Countries*, IMF Staff Papers, Washington: IMF; UNCTAD (1986), *Protectionism and Structural Adjustment*, Geneva; and I. Trela and K. Whalley (1990), "Unravelling the Threads of the MFA", in C. Hamilton, ed., *Textiles Trade and the Developing Countries: Eliminating the Multi-Fibre Arrangement in the 1990s*, Washington: World Bank.

[193]A special transitional safeguard mechanism, which permits new quotas under strict conditions, is available to protect Members against damaging surges in imports of products not yet integrated into WTO rules. The safeguard mechanism was applied on 23 occasions in the first half of 1995 although in the past 22 months it has been invoked much less frequently.

[194]Data from UNCTAD (1996), *Trade Analysis and Information System (TRAINS)*, Geneva.

was reduced by 40 per cent. In addition, only 4 per cent of tariff lines of imported textile and clothing imports were duty free in developed countries; 27 per cent were in the range of 15 to 35 per cent. The corresponding figures for all manufactured products were 49 per cent and one per cent respectively. Tariffs on imported textiles and clothing remain high in many developing countries.

(d) Subsidies

178. Subsidies are not usually associated with textiles and clothing production. However, there are indirect subsidies to inputs into the production processes. For example, in many countries, cotton cultivation relies on a complex mix of price and income support schemes, including grants, loans and other subsidies. As noted in the earlier section of this Note on agriculture, subsidies applied to agricultural production in general have been viewed as contributing to the over-use of chemical fertilizers and pesticides, while in some instances imposing a heavy financial burden on government authorities which could be better employed to implement appropriate domestic environmental policies. Another form of indirect subsidy is the under-pricing of freshwater inputs used in cotton cultivation. An estimated 60 per cent of the world's cotton is produced using irrigation methods, and the general underpricing of freshwater inputs is frequently viewed as contributing to environmental problems, including creating a disincentive for the conservation of increasingly scarce freshwater resources.

C. Environmental Benefits

179. The most prominent development leading to the removal of trade restrictions and distortions in the coming years - and therefore any ensuing environmental benefits - is the phase out of the MFA.

180. In exploring the relationship between trade liberalization and environmental benefits in the textile and clothing sectors, potential benefits can be broadly divided into two groups: first, general welfare benefits which are expected to accrue to developing countries because of the MFA removal and further tariff reduction; and second, environmental benefits which may arise because of changes in the structure of production.

181. With respect to the former, it has been estimated that - as noted earlier - world income from the liberalization of all trade in goods will increase by up to $510 billion annually by the year 2005. The largest increases are projected to occur in apparel (60 per cent), due primarily to the two-pronged liberalization to be achieved through the removal of quotas and the concurrent reduction in tariffs. While the removal of trade restrictions and distortions would have important income effects in many developing countries, the distribution of revenue gains will depend on a number of economy-wide as well as sector-specific considerations.[195]

182. As in other sectors, it is difficult to quantify changes in environmental outcomes due to changes in the structure of production that result from trade liberalization. Environmental problems that relate to the structure of production are, however, associated with the production of cotton and the finishing of textiles. As in some other agricultural sectors, subsidies applied directly to cotton production have led to the extensive use of agro-chemicals. Cotton is a chemical intensive crop; there is frequently

[195]Kym Anderson (1993), "Textiles and Clothing in Global Economic Development: East Asia's Dynamic Role", *World Competition*. Anderson makes the following observation based on data concerning production intensity: "(a) that the shares of primary products in total exports and of textiles and clothing in manufactured exports will be higher in developing economies than in advanced industrial economies; (b) that these shares will tend to decline over time in all economies; (c) that the declines will be faster in economies that are growing relatively rapidly; and (d) that within each of these two groups, relatively densely populated economies will tend to have lower shares of exports, due to primary products, and higher shares, due to textiles and clothing."

a high pesticide, herbicide and fertilizer input intensity applied during the cultivation of cotton[196], which has eroded the soil and polluted water resources.[197] Changes in cotton demand have in part been driven by technological changes in textile production: for example, developments in machine capacity and automation have resulted in increased demand for improved cotton quality, in terms of fibre strength and uniformity. This, in turn, has led to changes in cotton breeding in response to increased demand for high-quality cotton varieties, the cultivation of which relies heavily on pesticides.[198]

183. The restraint arrangements under the MFA have led many exporting countries to produce higher quality garments with higher per unit value added and better quality yarn inputs, the latter relying on cotton cultivated with an input of pesticides.[199] With the phase out of the MFA, exporters will produce according to their comparative advantage rather than respond to incentives distorted by trade restrictions.

184. Fertilizers are also used intensively for land irrigation purposes in cotton production, and several case studies have shown extensive use (in some cases 150 times the recommended quantity per hectare) of fertilizers, leading to nitrogen-related environmental problems.[200] As noted in the Section II of this Note dealing with agriculture, the removal of subsidies would be expected to lead to a price increase for fertilizers and pesticides, a reduction in input intensity and a corresponding reduction in the environmental damage associated with agro-chemical use.[201] Similar price reforms to increase the cost of water and energy inputs may also have environmental benefits.

185. With respect to textiles production, the two principal environmental problems are the discharge of different polluting effluents at different stages of processing, and the high consumption of water and energy inputs. Liquid wastes arise from textile washing operations and may contain substantial quantities of organic and suspended pollution loads such as fibres, grease and various toxic chemical effluents.[202] For example, the production of synthetic fibres is linked to the release of monomers in the air and water, together with volatile organic compounds. Polymer and other synthetic fibre production is also energy-intensive, and removing energy subsidies would also restrain energy use

---

[196]Cotton remains the leading textile fibre. An estimated 19 million metric tonnes of cotton is cultivated each year (1994/1995), of which textile fibre input comprises more than 50 percent of total production. *See* UNCTAD (1995), *Guidelines for Facilitating Access to Risk Management Markets Through the Stimulation of Local and Regional Exchanges: The Case of Cotton in the Near East/CIS/Pakistan*, (UNCTAD/COM/65), Geneva.

[197]*See* V. Bharucha (1997), "The Impact of Environmental Standards and Regulations Set in Foreign Markets on India's Exports", in V. Jha, G. Hewison and M. Underhill, eds., *Trade, Environment and Sustainable Development: A South Asian Perspective*, London: Macmillan.

[198]H. M. Eisa et. al. (1994), *Cotton Production Prospects for the Decade to 2005*, Washington: World Bank.

[199]One estimate suggests that approximately 25 per cent of world pesticide use is applied to cotton cultivation, involving over 30 different pesticide varieties, including persistent organo-halogens or arsenic-based pesticides which generate particularly adverse environmental effects such as surface and drainage water contamination, and lake eutrophication. Cotton production costs have increased significantly because of the increased use of both fertilizers and pesticides required to achieve higher yields and specified quality targets. It has been noted that in many cases, increased agro-chemical use has created additional problems related to insect control because natural enemies are eliminated by chemical use, while resistance to major cotton pests has continued to increase. *See* M. Lehtonen (1997), *Criteria in Environmental Labelling: A Comparative Analysis of Environmental Criteria in Selected Labelling Schemes*, UNEP Environment and Trade Series, No. 13, Geneva: UNEP.

[200]A. Daniel and B. van Elzakker (1997), "Cotton and Organic Cotton Cultivation and Processing in India", Geneva: UNCTAD; C. Aruoba (1996), "Case Study of Organic Cotton and Textiles in Turkey", Geneva: UNCTAD.

[201]Studies, including contamination of groundwater, have identified various environmental effects of pesticides, and long-term effects of banned pesticides (e.g. 1,2-DCP, DBCP and EDB).

[202]UNEP (1993), *The Textile Industry and the Environment*, Technical Report No. 16, Paris: UNEP.

in this segment of production. Production-related environmental externalities include liquid waste emissions containing organic and suspended loads including fibres and grease removed from raw natural fibres during processing, as well as water pollution containing chemical residues which may be toxic. To the extent that the removal of trade distortions and restrictions leads to a continuation of the process of industrial restructuring, new investment will provide the possibility to introduce more environmentally-friendly production processes and machinery.

186. In a number of countries, standards have been developed stipulating specific requirements for textiles in terms of their use of caustic soda and dermatologically-safe materials in synthetics. These standards extend to dyes containing carcinogenic components or ingredients. Another dimension of the sector is the continued growth in environmentally-friendly products. For example, the International Federation of Organic Agriculture Movements anticipates a rapid increase in the world share of organically-grown cotton[203], with higher than average growth in the export performance of some developing country cotton textile producers. Exports from countries which have relied on environmentally-friendly dyestuffs is expected to continue.[204]

VIII. LEATHER

A. Overview

187. In the 1990s South-East Asia emerged as the most important supplier of a large number of leather products to the international market. The principal exporters of leather goods in Asia import most of their raw materials (hides and skins). Industrialized countries have become net exporters of raw material in the leather sector, and net importers of value-added leather products.

188. The leather sector can be divided into four broad categories on a regional basis: (a) industrialized countries in North America and the European Union (except Italy, Portugal and Spain); (b) Australia, Japan, and New Zealand; (c) countries of East, South-East and South Asia (China, India, Indonesia, Pakistan, Republic of Korea, Thailand, and Viet Nam), South America (Brazil, Mexico), and Portugal and Turkey in Europe; and (d) countries in Africa and smaller countries of South America and South/South-East Asia.

189. Leather products can be divided into six main categories: footwear, garments, upholstery, gloves, leather goods (defined as, brief-cases, trunks, suit-cases, handbags, wallets, etc.), and heavy leather.[205] Footwear accounts for approximately 60 per cent of all leather products traded globally, leather garments about 15 per cent, leather accessories and miscellaneous goods another 20 per cent, while saddlery and upholstery account for the remaining 5 per cent.[206] The pattern of leather consumption has followed the pattern of production of leather products. The footwear industry absorbs approximately 60 per cent of the world's leather; garments consume 10-15 per cent, and gloves 1-2 per cent. In response to

---

[203]Cited in UNEP (1997), *Criteria in Environmental Labelling*, No. 13, Geneva: UNEP. Also *see* ITC (1996), *Eco-labelling and Other Environmental Quality Requirements in Textiles and Clothing: Implications for Developing Countries*, Geneva.

[204]IIED (1997), *Unlocking Trade Opportunities*, London: IIED.

[205]*See* ITC (1993), *Leather Goods, A Practical Guide for Exporters in Developing Countries*, Geneva.

[206]*See* Economic and Social Commission for Asia and the Pacific (ESCAP) (1994), *Development of Leather and Leather Products In the Developing Countries of the Asian and Pacific Region Through Export Marketing and Regional Cooperation*, New York: United Nations.

growth in production of upholstery and leather goods in the 1980s, their share in leather consumption has increased greatly, and is at approximately 6 per cent of world leather.[207]

190. All types of leather are used to produce these goods. The bulk, however, is produced from the skin/hide of calves, cattle and buffalo, sheep, goats, reptiles and, to a lesser extent, from pigs, horses, donkeys and camels, deer and elk, and many species of exotic animals. Leaving the reptile and other exotic hides and skins aside, the best and most expensive qualities are usually full-grain aniline-finished calfskin leathers.[208]

191. World trade in leather and leather products has grown steadily since the 1970s: from US$4 billion in 1972, US$16 billion in 1985 and US$42 billion in 1992 to a projected US$60 billion in the year 2000.[209]

B. Trade Restrictions and Distortions

192. Average tariffs on world trade in leather and leather products remain relatively high, even after the implementation of the commitments undertaken in the Uruguay Round. Post-Uruguay Round average tariffs on imported leather and leather products into the developed countries is estimated to be 7.3 per cent. This is almost double the average for all industrial products of 3.8 per cent.[210]

193. Tariff escalation is observable for most countries involved in trading leather and leather products, both developed and developing. However, while few industrialized countries levy import tariffs on raw hides, import tariffs rise with the level of processing; from hides to leather, and from leather to manufactured leather goods, such as shoes.[211] In Canada, the European Union, Japan and the United States, for example, tariffs escalate from raw materials, semi-manufactures to finished products in each of the countries, even after the implementation of the Uruguay Round tariff valuations. The average across these four countries for the stages of production referred to are 0 per cent, 4.8 per cent and 12.1 per cent respectively.[212]

194. A number of countries which export raw materials levy export taxes to protect their domestic processing industry. Higher stages of processing are protected by progressively lower rates of export taxes, i.e., rates "de-escalate" as processing advances. Export subsidies on manufactured leather goods are also employed to encourage higher levels of processing. While export restrictions in developed countries at any processing level are rare, developing countries commonly restrict the export of hides and leather and, in certain instances, impose export bans.

195. Examples of non-tariff measures affecting leather and leather product imports include: sanitary requirements, import deposits, compulsory national transportation and quotas. Examples of non-tariff

---

[207] *See* ITC (1993), *Leather Goods, A Practical Guide for Exporters in Developing Countries,* Geneva.

[208] Ibid.

[209] *See* ESCAP (1994), *Development of Leather and Leather Products In the Developing Countries of the Asian and Pacific Region Through Export Marketing and Regional Cooperation*, New York: United Nations.

[210] *See* GATT (1994), *The Results of the Uruguay Round*, Geneva.

[211] *See* FAO (1994), *Trade in Hides, Skins and their Derived Products*, Rome: Committee on Commodity Problems, Intergovernmental Group on Meat, Sub-Group on Hides and Skins, FAO.

[212] *See* GATT (1994), *The Results of the Uruguay Round*, Geneva.

measures affecting leather and leather product exports include: sanitary requirements, prohibitions, quality controls and licensing. The overall impact of these non-tariff measures on exports of developing countries is difficult to estimate, but could be significant, particularly when considered along with stricter environmental standards in developed countries.

C. Environmental Benefits

196. The production of leather and leather products has a considerable impact on the environment, beginning with the production of hides and extending through the entire leather production chain. The process of converting hides to leather end-products includes the following stages: (a) production of hides; (b) chemical processing: liming/deliming, pickling, tanning, dyeing, and finishing; (c) mechanical processing: cutting, grading, making-up, sewing; and (d) packaging.[213]

197. The production of leather results in a number of local environmental problems: (a) water pollution: the discharge of untreated effluents to surrounding waterbodies, and the resultant pollution of groundwater; (b) soil contamination: the discharge of untreated effluents to surrounding fields, as well as the disposal of toxic and hazardous waste in these fields; and (c) solid waste generation: the generation of waste, including toxic and hazardous waste, in the absence of adequate waste disposal systems.[214]

198. Few studies exist on the impact of trade liberalization on the environment in the leather industry, and it is difficult to speculate on the outcome of liberalization in this regard. However, it is argued that the income growth effect of trade liberalization could result in environmental improvements. Trade liberalization increases national income, contributing to poverty alleviation. In developing countries, employment typically increases in export-oriented labour intensive activities, such as production of leather goods. Increased income leads to increased demand for improved sanitation facilities and creates a larger tax base from which to fund public projects. Improved infrastructure, in the form of better sewerage systems and more waste water treatment plants, could alleviate many of the environmental problems associated with leather production. In addition, trade liberalization could lower the cost of importing pollution control technologies and more eco-friendly inputs, thereby affecting the environment positively.[215]

199. A recent study has concluded that although the recent focus on environmental considerations has placed new requirements on the leather industry in some developing countries, there have been some positive effects. Natural products such as biocides, oils and fats, vegetable dyes and protein binders have become more popular. Vegetable-tanned leather is likely to be in greater demand by green consumers. In short, while difficulties were found to exist in having domestic tanneries respond to the environmental regulations of their trading partners (in one particular case, with cost of using PCP substitutes being 10 time higher than that of using PCP), it was found that tanneries were able

---

[213]*See* FAO (1994), *Environmental Aspects of Processing and Trade in Hides, Skins and Leather*, Rome: Committee on Commodity Problems, Intergovernmental Group on Meat, Sub-Group on Hides and Skins, FAO.

[214]Ibid.

[215]Leather tanning has been ranked as one of the most polluting activities compared to other manufacturing sectors with a high level of toxic intensity per unit of output (Brandon and Romankitty, 1993). Some studies have revealed that countries which adopt open and outward oriented development strategies have reduced the pollution intensity of production as their income per capita has increased. These countries have adopted more readily environmentally sound technologies compared to countries with closed economies (Birdsall and Wheeler, 1992; Lucas, Wheeler and Hettige, 1992). These results have, however, been questioned and an alternative view has been expressed (Rock, 1966). These conclusions were drawn from a case study on trade, environment and development, conducted in the Philippines, *see* UNCTAD (1995), *Trade, Environment and Development: Lessons from Empirical Studies; The Case of the Philippines*, Geneva.

to adapt to new market segments (green consumers) by using more environmentally-friendly inputs in the production process.[216]

200. Small and medium sized enterprises (SMEs) characterize the leather industry in both developing and developed countries. Despite the success of the leather industry in many countries, SMEs suffer from, limited production capacity, limited product development capacity, and lack of quality assurance. SMEs do not have always access to timely information on environmental regulations; especially since they typically do not have direct contact with importing firms, and do not have the resources to easily adapt their production process.[217] These problems encountered by SMEs are particularly acute in developing countries.

201. Trade liberalization can lead to the structural transformation of the leather industry in developing countries. One case study has found that the focus has shifted from the export of raw hides and skins to the export of higher value-added goods, such as shoes.[218] Trade liberalization has the potential to induce diversification of exports. With a shift towards higher value-added goods, production may be less pollution intensive, and environmental benefits may ensue. There is also evidence that trade liberalization may spur the establishment of more joint ventures, contributing to the adoption of cleaner technology. Bangladesh, Italy, Germany, former Czechoslovakia and the United Kingdom are the leading suppliers of modern leather production machinery and equipment, although some locally produced machinery (such as paddles, wooden drums, and toggle driers) are still used. A number of joint venture projects have been established in Bangladesh using technology from firms located overseas.[219] However, appropriate domestic environmental regulations in the leather sector would also be needed to encourage the adoption of such technology.[220]

---

[216]*See* V. Jha (1997), "Protection of the Environment, Trade and India's Leather Exports", in V. Jha et. al., ed., *Trade, Environment and Sustainable Development, A South Asian Perspective*, London: Macmillan.

[217]*See* S. Das *(1996), The Differential Impact of Environmental Policies on Small and Large Enterprises in India with Special Reference to the Textile and Clothing and Leather and Footwear Sectors.*

[218]*See* V. Jha (1997), "Protection of the environment, Trade and India's Leather Exports", in V. Jha et. al., ed., *Trade, Environment and Sustainable Development, A South Asian Perspective*, London: Macmillan.

[219]*See* F. Mahtab (1997), "The Sustainable Development of Leather Industries in Bangladesh", in V. Jha et. al., ed., *Trade, Environment and Sustainable Development, a South Asian Perspective*, London: Macmillan.

[220]*See* UNIDO (1993), *The World's Leather and Leather Products Industry*, Vienna: UNIDO.

Appendix Table
World Merchandise Trade by Product and by Region, 1996

(Source: WTO (1996), *Annual Report*)
(Billion US dollars)

Destination / Origin	World					North America					Latin America				
	Agricul.	**Fuels**	**Non-ferrous Metals**	**Textiles**	**Clothing**	**Agricul.**	**Fuels**	**Non-ferrous Metals**	**Textiles**	**Clothing**	**Agricul.**	**Fuels**	**Non-ferrous Metals**	**Textiles**	**Clothing**
World	***585.8***	***415.8***	***100.2***	***150.2***	***163.3***	65.8	79.3	16.7	13.7	40.9	31.1	21.6	3.1	7.3	7.0
North America	113.5	32.7	15.1	9.7	8.8	27.7	20.6	8.0	3.7	1.7	13.3	3.6	1.3	2.4	4.9
Latin America	61.8	38.4	10.3	3.8	9.4	15.5	23.2	2.4	1.4	8.3	11.0	11.1	1.3	1.7	0.7
Western Europe	246.3	90.6	37.9	65.3	58.9	10.0	9.4	2.5	3.0	3.2	4.6	0.8	0.3	0.8	0.4
Central/Eastern Europe/BS/CIS	23.8	31.3	14.3	3.8	7.5	0.8	0.4	2.0	0.2	0.4	0.5	0.7	0.05	0.01	0.0
Africa	21.9	47.2	4.0	1.4.	6.0	1.1	13.2	0.8	0.1	0.6	0.3	2.1	0.0	0.0	0.0
Asia (including Oceania)	111.9	57.2	16.60	64.1	69.6	10.5	1.9	1.0	5.2	25.8	1.5	0.5	0.1	2.3	0.9

Destination / Origin	Western Europe					Central/Eastern Europe/BS/CIS					Asia				
	Agricul.	**Fuels**	**Non-ferrous Metals**	**Textiles**	**Clothing**	**Agricul.**	**Fuels**	**Non-ferrous Metals**	**Textiles**	**Clothing**	**Agricul.**	**Fuels**	**Non-ferrous Metals**	**Textiles**	**Clothing**
World	265.9	145.2	45.0	59.1	77.6	27.4	16.8*		n.a.	n.a.	148.6	131.1	28.9	48.0	26.0
North America	18.0	3.3	2.4	1.6	0.7	2.8	0.2	0.0	0.1	0.0	44.3	4.3	3.0	1.4	1.2
Latin America	19.5	2.6	3.1	0.4	0.3	1.6	0.0	0.0	0.0	0.0	10.2	1.2	3.4	0.2	0.0
Western Europe	185.7	72.3	29.1	45	45.9	14.5	2.1	1.0	6.7	3.5	15.0	1.0	3.1	4.6	4.6
Central/Eastern Europe/BS/CIS	11.9	19.3	8.1	2.5	6.7	5.2	8.9	1.1	0.8	0.3	3.4	0.8	2.5	0.2	0.0
Africa	12.4	24.0	1.1	0.8	5.2	0.5	0.5	0.0	0.0	0.0	4.4.	4.6	1.9	0.1	0.0
Asia (including Oceania)	15.9	1.9	0.9	7.95	17.9	2.1	0.2	0.1	0.8	1.9	70.7	51.6	13.9	41.4	20.1

Destination / Origin	Africa				
	Agricul.	**Fuels**	**Non-ferrous Metals**	**Textiles**	**Clothing**
World	20.4	11.2		n.a.	n.a.
North America	3.7	0.4	0.0	0.1	0.0
Latin America	2.0	0.2	0.0	0.0	0.0
Western Europe	8.2	1.5	0.5	3.4	1.1
Central/Eastern Europe/BS/CIS	0.5	0.2	0.0	0.0	0.0
Africa	2.7	2.7	0.1	0.3	0.1
Asia (including Oceania)	2.9	0.2	0.1	2.1	0.7

ANNEX

METHODOLOGIES

1. Measuring the net effects of trade liberalization on the environment is complex. The implications of the removal of the trade restrictions and distortions will depend on not only the nature of the measure in question but also the state of the environment at the time of liberalization. For example, in an instance of over-consumption of a scarce resource linked to underpricing, a price increase associated with a subsidy removal would be expected to decrease the rate of resource use and waste, thereby contributing to an environmental improvement. However, a reduction in tariffs for the same environmental problem may have the opposite effect, by increasing the rate of consumption of the scarce resource.

2. Ideally, any analysis of the link between trade measures and the environment should be based on empirical data which quantifies the *proportion* of environmental externalities which stem from distortionary policies *prior* to liberalization. This is difficult at best, given the scarcity of data measuring the ecological effects of distortionary economic policies.[1]

3. Environmental benefits may well be viewed in net terms; there may be a net improvement in the environment relative to what would have occurred in the face of continued distortionary policies.[2] Thus, optimal environmental policy does not imply production or consumption activity devoid of environmental costs, but rather a balance between costs and benefits. This balance differs by sectors, countries and ecosystems.

4. Environmental sciences can provide precise data on various aspects of environmental quality; for example, levels of different pollutants, changes in chlorinated compounds, declines in forest cover and increases in carbon emissions. While many aspects of environmental changes and trends in environmental quality can be measured objectively, the measurement of environmental benefits is value-laden, as it reflects different societal goals.[3] It is widely assumed that realizing environmental benefits depends not only on removing distortionary trade policies, but also establishing complementary policies, including removal of non-trade economic distortions and the use of appropriate environmental policies. These three facets of policy reform are illustrated in the diagram below showing a one-country scenario in which multilateral trade liberalization has expanded production in forestry.[4]

---

[1]One approach may be to compare the environment for given sectors between closed and open economies; another could be to measure changes in environmental data prior to and following trade liberalization.

[2]A number of studies related to structural adjustment assume that environmental costs in closed economies are more pronounced than those in open economies. *See* UNEP (1995), *Economic Policy Reforms and the Environment: African Experiences,* UNEP Environment and Trade No. 11, Geneva.

[3]It has been suggested that a "vector" of indicators showing trends towards a more general environmental situation would be useful. *See* Arthur L. Dahl (1996), "Measuring the Unmeasurable", *Our Planet,* UNEP, Vol. 8, No. 1.

[4]Based on M. Munasinghe (1996), "An Overview of the Environmental Impacts of Macroeconomic and Sectoral Policies" in M. Munasinghe, ed., *Environmental Impacts of Macroeconomic and Sectoral Policies,* World Bank: Washington.

Increasing Environmental Benefits via income, price and policy change

5. Let the initial rate of deforestation be Qo. The sustainable rate of forestry management is assumed to be QL. That is, the level of logging prior to trade policy reform is below the sustainable level. The removal of trade restrictions and distortions is assumed to move the demand curve outward to D1, representing the additional demand from the world market. This increases demand to Qs at the pre-reform price of Ps. Since the rate of logging has moved beyond the sustainable forestry rate, corrective domestic policies are needed to ensure that logging does not exceed QL. One way would be to raise or introduce stumpage fees to an appropriate level, coupled with the introduction of well-defined private property rights (which in most cases introduce incentives not to overtax the resource base). The introduction of these measures would more accurately capture the opportunity costs of the forestry activities, which would be reflected in a price increase from PS to PE. Rather than relying on quantitative restrictions to constrain supply, the price increase would decrease the deforestation level from QS to QE. Under this scenario, the environmental benefit would be the relative decline in deforestation from QS to QE. However, this is still a sub-optimal result since deforestation exceeds QL. The role of environmental policy is to move the deforestation rate from QE to QL. Various options can be used to further increase price. A tax could be used to increase the price from PE to PL, with the tax rate calculated by valuing various external environmental costs linked to excessive deforestation, such as the loss of wetlands, biodiversity or carbon sinks.

6. An additional consideration to bear in mind is that the removal of trade restrictions and distortions and the related changes in relative prices have economy-wide and multi-sectoral effects. It is difficult to isolate environmental benefits in one sector without taking into account changes occurring in other sectors. For example, a number of case studies suggest that trade liberalization alters the pollution intensity within the manufacturing sector. An increase in production intensity in one sector can have intersectoral effects which influence environmental quality on other sectors manufacturing activity because trade liberalization can affect pollution intensities and in turn affect, for example, changes in agricultural productivity because of air and water pollution. In addition changes in relative prices will induce changes in the economy-wide allocation of resources; the use of capital and labour will change in other sectors. By way of example, the following matrix illustrates the range of secondary effects which may arise from trade liberalization in the agricultural sector:

	Countries with expanding agriculture	Countries with contracting agriculture	Trans-border and global effects
Agricultural production	Increased value of farm land, leading to increased incentives for conservation. Increased land conversion from forests, wetlands and/or marginal lands to agriculture production. Mixed outcomes including aesthetic changes in the landscape with benefits depending on public preference.	Retirement of some agricultural lands; disused land may be left idle, planted with forests or agroforestry projects, used as migratory corridors, or left as wetlands. Mixed outcome including aesthetic changes in the landscape with benefits depending on public preference.	Overall effects depend on possible changes in global ecosystem functions: for example, possible changes in carbon sinks because of an increase or decrease in forests, increase or decrease in biodiversity-rich areas because of land conversion or retirement, changes in watersheds, etc..
Total use of pesticides, fertilizers, herbicides, other inputs.	Possible increase in the use of agrochemicals.	Possible reduction in the use of agrochemicals.	Effects depend on relative change in the per unit intensity of agrochemicals and effects of run-off on transboundary rivers, oceans, and effects on biodiversity, etc.
Indirect effects	Depends on economy-wide changes in resource allocation. Environmental issues associated with different sectors, and whether other sectors expand or contract as a result of agricultural expansion or contraction.		
Income effects	World income increases as tariffs are reduced, as economies specialize according to comparative advantage. Higher income may have indirect effects on production technologies, domestic regulations, private property rights, consumer choice, public policy choice, etc.		

7. Another methodological consideration which is important in measuring the relationship between the removal of trade restrictions and environmental quality is the link between the economic growth engendered by the trade liberalization and the pollution levels in the country in question. One view is that during manufacturing expansion and growth in per capita income, the absolute level of pollution per unit of wealth increases up to a point and then decreases. This is known as an inverted U-shaped curve or an environmental Kuznet's curve[5], although various important qualifications have emerged with respect to its use. Recent literature suggests that the income effects vary greatly depending on environmental implications being considered (e.g. per unit output of sulphur dioxide emissions versus greenhouse gas emissions or biodiversity preservation) and that conclusions about the income growth-environmental outcome correlation is ambiguous at best. Some have argued that pollution per unit

[5]The toxic chemical intensity of GDP used in Lucas, Wheeler and Hettige (1992) and Wheeler, Martin and Stengren (1992) extrapolated values for each of three pollution intensity variables from a 1987 USEPA Toxic Release Inventory study of 320 toxic chemical pollutants released into the air, water and land from 15,000 factories. Toxic chemicals on the TRI list include organics, acids, metals, haloorganics, nonmetallic inorganics and mixtures. Classified in toxicity as carcinogens, ozone depleters or chloro-organics. Convention pollutants such as suspended particulates, carbon dioxides, sulphur dioxides, were not included in the original matrix based on the TRI. *See* N. Birdsall and D. Wheeler (1992), "Trade Policy and Industrial Pollution in Latin America: Where are the Pollution Harens?" in P. Low, ed., *International Trade and the Environment,* World Bank: Washington; R. Lucas, D. Wheeler and H. Hettige (1992), "Economic Development, Environmental Regulation and the International Migration of Toxic Industrial Pollution: 1960-1988" in Low, Ibid. This Note includes data on leather tanning, textiles and clothing and non-ferrous metals, each of which exhibits very high toxic pollution levels relative to other manufacturing sectors. According to one industry ranking of per unit chemical toxicity, out of 36 industries surveyed, tanneries and leather is ranked third, textiles is ranked seventh and non-ferrous metals is ranked ninth. It is unclear whether non-manufacturing sectors - including resource-based sectors like fisheries and forestry - are relevant from the perspective of the Kuznet's curve. *See* G. Grossman and A. Krueger (1992), "Environmental Impacts of a North American Tree Trade Agreement", London: CEPR Discussion Paper 644; G. Grossman and A. Krueger (1995), "Economic Growth and the Environment", *Quarterly Journal of Economics*, 3(110).

of output in manufacturing (or pollution intensive sectors) continually increases with income.[6] Some studies have also suggested that the ratio of per unit output of toxic pollution per unit of income may decline not because of the introduction of cleaner production methods, but rather because of an absolute shrinkage in the manufacturing sector relative to the services sector.[7] It also is unclear to what extent the curve effect functions outside of manufacturing activities, as in the past, income-pollution intensity links have concentrated on manufacturing.[8]

8. Because of the intersectoral implications of changes in the environment, models have been used extensively in showing, for example, the effects of changes in air quality, economic consequences of reducing carbon emissions, stratospheric ozone or (in recent years) in synthesizing hundreds of thousands of data concerning climate. Models have also been used to measure different environmental effects of economy-wide policies, in particular macroeconomic reforms, and include non-pricing or institutional variables such as the role of private property rights in forestry management.[9] Among the findings of the general equilibrium modelling is that given the degree of intersectoral linkages, including indirect environmental side-effects of changes in both economic and non-economic variables which affect the environment, optimal environmental policies should pay particular attention to the sequencing of liberalization.[10] The models also point to the importance of the specificity of the conditions to which they pertain. In particular, most models are based on country or region-specific environmental effects which cannot be replicated in examining environmental outcomes in other countries or regions.

---

[6]S. Van Hijnberger (1992) "Discussants Comments to M. Lopez - The Environment as a Factor of Production" in P. Low, op. cit.; M. Rock (1996), "Pollution Intensity of GDP and Trade Policy: Can the World Bank be Wrong", *World Development*, Vol. 24, No. 3.

[7]J. Beghin and M. Potier (1997), "Effects of Trade Liberalization on the Environment in the Manufacturing Sector", in *The World Economy*, Vol. 20, No. 4.

[8]C. Brandon and R. Ramankutty (1993), *Toward an Environmental Strategy for Asia*, World Bank Discussion Paper No. 224, World Bank.

[9]In this regard, a recent World Bank report noted that "Currently, the economic analysis of environmental issues relies mainly on project level studies, using cost-benefit analysis and environmental assessments. However, economy-wide policies (both macroeconomic and sectoral) frequently have much more powerful economic effects than mere project level investments. Some progress has been made in identifying the environmental consequences of sectoral policies involving, for example, energy, water or agricultural pricing. Nevertheless, the impacts of broad macroeconomic reforms (such as exchange rate devaluation, trade liberalization, privatization, and other fiscal and monetary stabilization policies) on natural resources and pollution management are far more difficult to trace." Various models, generally CGE models, have been developed to capture different sectoral linkages. For example, one model includes data on economic activities affecting deforestation in Costa Rica, which simulates the effects of introducing property rights on forestry management, as well as markets for logs and cleared land. A. Persson and M. Munasinghe (1997), "Natural Resource Management and Economy-wide Policies in Costa Rica: A Computable General Equilibrium Modelling Approach," in W. Cruz et. al., ed., *The Greening of Economic Policy Reform*, Washington: World Bank.

[10]*See* also K. Maler and M. Munasinghe (1996), "Macroeconomic Policies, Second-Best Theory, and the Environment" in M. Munasinghe, ed., op. cit.; and L. Unemo (1996), "Environmental Impact of Governmental Policies and External Shocks in Botswana: CGE Modelling Approach", in M. Munasinghe, op. cit.