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PPP Plus: Towards Full Resource Pricing for LDC Primary Exports

Henk L.M. Kox

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Henk L.M. Kox[*]

Summary: Internalisation of environmental costs through the Polluter-Pays Principle (PPP) is widely encouraged. This guiding principle normally assumes that real, additional environmental costs can be passed on to consumers (User Pays). Application of a PPP policy may be difficult for industries which export a large share of their production. If competition in export markets is such that additional production costs due to environmental measures cannot be passed on to international consumers, the profit margin on export commodities is eroded and export is consequently discouraged. This situation prevails for many primary export commodities of developing countries. Since the latter countries depend strongly on those exports, implementation of environmental policy in primary export sectors will be very problematic when the incremental production costs due to such measures are substantial. Only international regulatory arrangements can restore the principle that consumers should in principle bear the full resource costs of the commodities they demand, and thus create a necessary precondition for domestic environmental policy in developing countries. The paper describes International Commodity-Related Environmental Agreements as potentially useful instruments to strengthen the internalisation of environmental costs.

Introduction

Both trade theorists and environmentalists consider internalisation of environmental costs in normal market prices as a desirable goal. In OECD countries and in a number of developing countries practical policy steps have taken to implement this goal, at least for some resources and environmental costs. OECD countries in 1972 adopted a set of guidelines incorporating the so-called Polluter Pays Principle (PPP) as the basis for shaping their environmental policies (OECD 1972; 1975). Since then broad international agreement has grown about the usefulness of these PPP guidelines, and not only in developed countries. In Principle 16 of the Rio Declaration all countries are called upon to apply the 'Polluter Pays' Principle as a guiding principle for their environmental policy:

> 'National authorities should endeavour to promote the internalisation of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment' (UNCED 1992).

The Polluter-Pays Principle is only offers directional guidance in policy development. An environmental policy on the basis of PPP may face several practical problems, and moreover, is not without costs, both with regard to policy implementation and with

* Dept. of Economics, Free University, De Boelelaan 1105, 1081 HV Amsterdam, Netherlands, fax nr: +31.20.444.6005, telephone nr: +31.20.444.6143 / 6140.

regard to the concomitant changes in consumption patterns and economic structure. Aspects of international competitiveness for industries facing PPP policies constantly loom large. For these reasons, environmental policies in OECD countries still do not systematically apply PPP in all relevant areas (e.g. Opschoor & Vos 1989). In developing countries, the internalisation of environmental costs through the PPP is still in its very infancy (e.g. Biggs 1993).

The question which will be asked in this paper is whether all 'Rio countries' can indeed be expected to implement PPP policies. Do the latter really fit their possibilities and current interests? This paper dissent with this view. It will be argued that for many developing countries the income effects and international competitiveness issues are very real obstacles to a consequent implementation of the PPP. To substantiate the intentions stated in the Rio Declaration additional international regulatory and financial arrangements will be required. This proposition will be further developed with regard to the internalisation of environmental costs in the prices of primary export commodities. International Commodity-Related Environmental Agreements will be described as potentially useful instruments to achieve internalisation of environmental costs and substantiate broad promises made at Rio.

Polluter Pays and/or User Pays?

If the price of a good or service does not, or incompletely, incorporate the costs of environmental inputs into its production and the welfare costs of pollution created by its production, we say that there are production externalities. In more general terms, an environmental externality is an effect of one economic agent's production or consumption activity on the consumption or production possibilities of other economic agents. The latter may include current and/or future local population in the production area, people downstream a river, the whole national population, or even people outside the production country. The existence of environmental externalities implies that costs and market prices do not reflect relative environmental scarcities and social preferences with regard to the environment. Such incorrect prices are likely to produce inefficient allocation of commercial and natural resources, both nationally and internationally. To end this situation, the environmental damage can be 'repaired', avoided or compensated. Box 1 sketches the main issues. PPP guidelines state that producers must be charged for the environmental costs they inflict upon a community or upon other private persons. Though the term 'Polluter Pays' could be understood as if only compensation issues are addressed, the OECD guidelines explicitly include pollution prevention and control measures.

Box I: The internalisation problem

Suppose that production of a given commodity creates negative net externalities to 'third parties', and that most of them are related to pollution emission. Suppose further that production of the commodity in each period (y_t) causes the emission of a fixed quantity of homogeneous pollutants (q_t), with α representing the proportionality factor:

$$q_t = \alpha \; y_t \qquad (i)$$

Let environmental quality in the production region be summarised in a single index variable E_t. The change in environmental quality is affected by three factors: pollution emission from commodity production, the pollution emission from other economic activities, and the regenerative process of nature. Pollution from other sources (q_t^*) and nature's regenerative process (R_t) are considered as given. The annual change in environmental quality can thus be formulated in the following form:

$$E_t - E_{t-1} = -\Omega_1 q_t - \Omega_2 q_t^* + \Omega_3 R_t = -\Omega_1 \alpha y_t - \Omega_2 q_t^* + \Omega_3 R_t \qquad (iia)$$

with ($\Omega_1, \Omega_2, \Omega_3 \geq 0$). Now suppose further that society has avoidance or reparation activity A_t at its disposal to minimise the negative environmental effects of pollution. With ($\Omega_4 > 0$) equation *(iia)* becomes:

$$E_t - E_{t-1} = -\Omega_1 \alpha y_t - \Omega_2 q_t^* + \Omega_3 R_t + \Omega_4 A_t \qquad (iib)$$

If the social objective is that environmental damage from commodity production should be completely neutralised, the following quantitative relation must exist between commodity production and avoidance/repair activity:

$$A_t = (\Omega_1 \alpha / \Omega_4) y_t + (\Omega_2 q_t^* - \Omega_3 R_t) / \Omega_4 \qquad (iii)$$

or, per commodity unit: $dA_t / dy_t = (\Omega_1 \alpha) / \Omega_4$ *(iv)*

Now suppose that the cost of one unit of avoidance activity is p_a. Full cost internalisation of externalities requires that the private unit cost price of production is elevated with the additional pollution avoidance or abatement costs. In that case, the private cost price (p_p) equals the social cost price (p_s):

$$p_p + (\Omega_1 \alpha / \Omega_4) p_a = p_s \qquad (va)$$

Of course, a society may decide not to insist on complete eradication of pollution, and to accept monetary compensation for the welfare loss due to the remaining pollution. The compensation amount could be derived by subjective, demand derived valuation methods, such as the revealed preferences method or the contingent valuation method. The compensation amount can be a direct transfer to affected private parties or a public tax. Suppose that β represents the part of pollution to be abated, and Z_t is the required monetary compensation for the remaining pollution. Now the relation between social and private cost prices can be described by:

$$p_p + [\beta (\Omega_1 \alpha / \Omega_4) p_a + (Z_t / y_t)] = p_s \qquad (vb)$$

Under a PPP policy producers have to pay for emissions, for non-complying with environmental standards, and for the use of natural resources. They will react in two ways to such a policy. First, they will try to limit the damage-causing activity by choosing better production methods. This is an incentive for environmental efficiency and innovation. Secondly, they will pass on the additional production costs to their customers. Ultimately, the final consumers will pay for the full resource costs of the commodities they demand, including the additional environmental costs. Competition ensures that the consumer is not charged too much, and that producers choose efficient technologies.[1] In this situation the PPP thus resolves into the *User Pays Principle.* The OECD guidelines explicitly acknowledge that 'from the view of conformity with the Polluter-Pays Principle, it does not matter whether the polluter passes on to his prices some or all of the environmental costs, or absorbs them'.[2] The User Pays Principle is sometimes also referred to as resource pricing or full resource pricing. In an informal document on proper pricing methods for natural resources the OECD Secretariat defines the User-Pays Principle as follows: '[T]he price for the use of a resource should be the full long-run marginal costs of using that resource including the external costs associated with its development and any resultant pollution prevention and control activities' (OECD 1988, in Dommen 1993: 149-155).

So far this is all nice theory for a closed economy. A major underlying precondition is that comparable producers are confronted with identical policy. Stated otherwise, there must be unity of policy. If the latter precondition is not fulfilled, then - all other things being equal - producers facing a tough environmental policy are put at a competitive disadvantage compared to those producers which face a more lenient environmental policy. In the end a lenient policy will drive out the tough policy through competitive forces. To guarantee unity of policy is mostly not too problematic in a national economy. Problems arise, however, in the international market. Here exporters have to compete with companies operating under different national policy regimes. In the world market national jurisdictions of sovereign governments prevail. Unity of policy is here an illusion due to the general lack of supranational structures and intergovernmental co-ordination.

Internalisation of environmental costs for export commodities

Most small economies cannot influence the world market for their export products. So, if PPP causes a substantial rise in production costs, the exporters cannot expect to

1) In a competitive market, where all producers face a cost increase due to the introduction of PPP, a new equilibrium will be established at a higher price level, close to the new production costs of the most efficient producers.

2) As stated in the supplementary notes (para 3) to the guidelines (OECD 1972).

recoup these costs from their international buyers. The necessary complementarity between environmental policy for domestic-oriented and export-oriented sectors comes under pressure. Very often producers produce by the same production methods identical goods for the domestic and the export industry. When a PPP policy induces higher production costs, it creates strange anomalies when only the supply price in the domestic market can be raised while producers themselves have to absorb the cost rise for export products. If only for credibility reasons, a complementarity in treatment of both is required. When only one group of consumers is charged for the additional environmental costs, this will sooner or later undermine the domestic credibility of environmental policy.[1)]

For large exporters the situation is different. They have some degree of monopoly power and their action will influence the world market price. With inelastic demand they can pass on the cost increase without a proportional loss of demand volume. The reaction patterns of other countries can, however, be such that in the longer term the initial advantage of the large exporting country is annihilated. Policy margins for individual exporting countries will thus converge in the long term.

The implication is that the User Pays Principle does not work for exports, certainly not for exporters with small market shares. Unilateral introduction of a PPP policy can thus create substantial difficulties for a country's export industry.[2)] Profit margins in the export sector shrink and exports become less attractive. The producer's normal reaction to a lower margin on export sales is to channel his products to the domestic market, or if this is not possible, to diminish export production and seek for income alternatives. Without further intervention, this effect may undermine the whole PPP-based environmental policy towards the industry involved. In developing countries, primary exports are often of utmost importance because they are the main commercial source of foreign exchange.

What can a government do to pursue its domestic environmental policy, while at the same time maintaining export levels? To avoid a lower export supply it has to financially compensate the domestic export producers through subsidies or border tax adjustment. In the first case the governments subsidises the export producers for the use of particular production methods, e.g. by channelling back environmental tax levied earlier, and/or by supplying 'fresh' (additional) subsidies. Border tax adjust-

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1) Domestic consumers are likely to regard a differential treatment as merely a form of taxation or suppression of domestic demand. Conversely, suppose a government would ask for international support for internalisation of environmental externalities in the price of export commodities, while failing to achieve internalisation in domestic prices. The international community will regard such an inconsistent policy as merely a form of rent-seizing. The significance of the complementarity argument depends, of course, on the export share in a country's total production.

2) The trade effects of unilateral environmental policy in a small open economies are well-documented in trade literature (e.g. Grubel 1976; Siebert 1977).

ments would correct for international differences in the level of environmental taxes which producers of a particular commodity have to pay. Exporters receive border tax rebates (refunds) for emission charges or other environmental taxes levied before. As a corollary, the adjustments can also apply to competing imports.

What can be said about the desirability of these compensatory measures? From a fiscal point of view they are less desirable. They form an additional burden for government finance, while many developing countries are wrestling with short-term fiscal deficits and austerity measures under structural adjustment programmes. Only refunding of earlier levied environmental taxes does not violate fiscal constraints. More serious are the objections from the point of view of environmental internalisation. The result of the compensatory measures is that foreign consumers continue to pay a price below full resource costs. Box 2 refines the concept of the hidden welfare transfer to foreign buyers due to underpriced export goods. A final objection relates to effect of the compensatory measures on international allocative efficiency. The measures in fact

Box 2: Hidden international welfare subsidies due to underpricing

Suppose like in Box 1 (equation *va*), that all environmental damage is to be neutralised instead of financially compensated. Assume this internalisation is achieved for the commodities sold in the domestic market, but that producers cannot pass on the cost increase in the form of a higher export supply price. The amount of the hidden welfare subsidy to foreign consumers (N_{wt}) can then be described as:

$$N_{wt} = [(\Omega_1 \alpha / \Omega_4) p_a] h_t y_t \qquad (vi),$$

in which h_t is the export share of production. The export share depends *inter alia* on the profitability of exports. Hence, the export share is inversely related to $(\Omega_1 \alpha / \Omega_4) p_a$. To countervail its export-lowering effect, the required export subsidy would have to compensate this at the border, so that most of N_{wt} is perpetuated.

imply that the gains from trade are 'bought' by subsidies, so that net gains may be low or even negative. The compensating border measures induce a 'beggar-thy-neighbour' effect and a downward harmonisation of environmental policy standards. National governments would be inclined to use commodity-specific or industry-specific measures to offset the influence of domestic environmental policy on the international competitiveness of their firms and industries (e.g. Walter 1974; Richardson & Mutti 1976). This could easily evolve into an inextricable jumble of compensating measures at the border, with damaging effects for international trade. With an increasingly integrated world trade and an increasing importance of environmental policy this effect is loom-

ing large. Current GATT rules discourage and in some cases forbid the use of subsidies to help domestic sectors meet environmental requirements,[1] but it is likely that the new WTO organisation in the future will have to spend considerable amounts of time to these problems. The common ground for international trade and environment problems will have to better demarcated. The most urgent motivation which led OECD countries to agreement on the PPP guidelines as early as 1972, was related to trade policy rather than to environmental issues as such. The guidelines were meant to prevent a broad-scale application of subsidies and tax exemptions for pollution control. This preoccupation is reflected in the name of the original PPP agreement, 'Guiding Principles Concerning the International Economic Aspects of Environmental Policies'. The 1972 PPP guidelines are as much a trade agreement than an agreement on the principles of environmental policy.[2]

The international competition effects of PPP policies remain problematic. A broad-scale use of subsidies and compensating border measures is unlikely for fiscal reasons, at least in developing countries, and undesirable for environmental and allocative efficiency reasons. Introduction of PPP policies in developing countries is unlikely when their adoption would cause a substantial rise in production costs.

Primary commodity exports and environmental externalities

The relevance of these general issues can be shown with regard to primary commodity exports of developing countries. Notwithstanding the fast industrialisation of many parts of the developing world, primary commodity exports like food commodities, agricultural raw materials, metals and minerals, and fuels, are the main export component for a vast majority of less-developed countries (LDCs). In 1991 the average primary commodity share in merchandise exports amounted to 68 per cent in the low-income countries (excluding India and China), while it was on average 56 per cent in the lower-middle income countries (World Bank 1993: 268-9). Moreover, many developing countries are highly dependent on a small number of primary export commodities. A group of 76 LDCs depended on average for more than fifty per cent of their export earnings on three or less primary commodities in the period 1987-1989. LDC market shares are often very small (UNCTAD 1992: 227-8). Currently, the direct

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1) Articles VI.3, VI.5, XVI and the Subsidies Code declare all subsidies subject to countervailing action by other nations. Just a limited section of subsidies is agreed upon as 'non-actionable'. In the Agreement on Subsidies and Countervailing Measures (Article 8.2c) governments are permitted to fund up to 20 per cent of one-time capital investments needed to meet new environmental requirements. Further elements of the new GATT/WTO agreement are that export subsidies for manufactured goods are completely forbidden and that agricultural export subsidies are to be reduced. With regard to border tax adjustments GATT only allows adjustments for (consumer) taxes on products, but not for taxes on production processes, even though the latter would be more desirable from an environmental policy point of view (e.g. Jackson 1992: 194-197, 255-273; GATT 1991; Esty 1994: 168-171).

2) Several of its articles (1, 9, 11, 13) explicitly refer to GATT provisions: national treatment, non-use of import levies and export rebates to compensate for inter-country differences in environmental policy, avoiding non-tariff barriers to trade.

contribution of primary exports to GNP averages at nearly twenty per cent in Subsahara Africa and eight per cent in South and Central America.

Production of primary commodities often forms an important cause of environmental degradation. A summary of empirical findings for six commodity groups is given in an annex to this paper. Till now only very few studies exist which try to quantify the magnitude of environmental externalities and, hence, real resource costs of commodity production in LDCs. On the basis of existing data - although the available studies often use different techniques, relate to different years, and vary in the quality of underlying research - Pearce & Warford (1993:28) make the guesstimate that total gross environmental damage in poor developing countries may be around 10 per cent of GDP and above. Even though the empirical basis for this generalisation is weak, it can safely be assumed that the economic implications of environmental externalities are non-trivial. A recent study on cotton has shown that production costs per unit (i.e. including yield effects) may rise with 30 per cent and more, compared to current 'standard' production costs, when the environmental externalities are to be abated (De Vries 1994). Estimates of the additional costs of avoiding water pollution in the Canadian non-ferro metal extraction averaged around ten per cent (Blunden 1985). A number of existing empirical studies are related to the consequences of deforestation, or to soil erosion in semi-arid regions like the Sahel or some other parts of Africa.[1)] Causality relations between environmental damage and commodity production are seldom straightforward. Non-trade causes of deforestation, like fuelwood needs for the local community or land clearance for agricultural purposes, are often even more important causes than timber extraction for export. The same accounting problem often exists in studies on local agriculture and overgrazing by livestock. These activities are as a rule not the only causes of erosion and land degradation. With these provisos in mind, it is possible to present some data on the economic importance of environmental degradation in commodity-producing LDCs. Table 1, basically an amended summary of existing study by Pearce and Warford (1993), reproduces estimates of actual environmental damage in terms of the gross domestic product of selected countries.

Before entering discussion on the possibilities of PPP policies with regard to LDC primary exports, it is important to point at two factors which influence the decision context of private commodity producers, and hence, also the ecological record of commodity production. The first is the role of current 'non-environmental' government policies. It is well-documented (e.g. World Bank 1992) that some policies, like productivity-enhancing measures, create disincentives for environmental protection, or

1) On the costs of deforestation, see e.g. Repetto et al. 1987 (Indonesia); WRI 1990 (Costa Rica); Paris & Ruzicka 1991 (Philippines). On soil erosion in African regions, see e.g. Bishop & Allen 1989; Mortimore 1989; Magrath & Arens 1989.

Table 1: Estimates of environmental damage in selected LDCs, various years

Country and year	Form of ecological damage	Annual costs as a percentage of GDP
Burkina Fasso 1988	Crop, livestock and fuelwood losses from land degradation	8.8
Costa Rica, 1989	Deforestation	7.7
Ethiopia, 1983	Effects of deforestation on the supply of fuelwood and crop output	6.0 - 9.0
Indonesia, 1984	Soil erosion and deforestation	4.0
Madagascar, 1988	Land burning and erosion	5.0 -15.0
Malawi, 1988	Lost crop production from soil erosion	1.6 -10.9
Malawi, 1988	Costs of deforestation	1.2 - 4.3
Mali, 1988	On-site soil erosion losses	0.4
Nigeria, 1989	Soil degradation, deforestation, water pollution, other erosion	17.4
Mexico, 1985	Natural resource depletion, deforestation, land use, environmental degradation	6 - 13 &
Papua New Guinea, 1993	Soil degradation, erosion, deforestation, water pollution, other resource depletion	7 - 10

Note: & represents percentages of Net Domestic Product. Sources: Pearce & Warford (1993:28); Van Tongeren et al. (1993); Fin. Times on study on UNEP/World Bank study (1994) for Papua New Guinea.

worse, stimulate environmental degradation by producers. Input subsidies like those on agrochemicals (pesticides, fertilisers), irrigation water and energy, lower the private marginal costs of these inputs below the social optimum. Linking land ownership titles to deforestation and land clearance also gives a wrong incentive to producers. So, before jumping to a PPP scheme, governments should first screen their own policy consistency. The second 'external' factor which influences producer behaviour is the long-term price trend for their products. Long periods of depressed international commodity prices in the 1980s had negative environmental consequences. It depressed income margins for commodity producers, lowered their investment capacity,[1)] and negatively affected fiscal revenues, thereby also limiting LDC governments margin for new environmental policy. Stable and rewarding price levels are themselves an important, though not sufficient, condition for environmentally benign producer's behaviour.

1) Low income margins may induce producers to refrain from environmentally desirable production methods, like investments in soil conservation, maintenance of irrigation and drainage systems, maintenance of the nutrient balance of the soil. This is repeatedly reported to be a standard reaction for many commodities which face depressed price levels (e.g. Akande 1993: 24). Small farmers have to seek for off-farm employment to maintain household income levels. The limited availability of labour power at their farms tends to be detrimental for all long-term maintenance activities, with often negative environmental consequences. A sometimes positive effect of low income margins is the forced reduction of pesticide spraying.

Internalisation problems with regard to LDC primary exports

Only a few, comparatively rich developing countries have dared to apply a full-fledged PPP policy in their primary export sector. It mostly happened in cases where the export share of the commodity was relatively small, or, reversely, where the country had a large share in the world market.[1] The latter condition applies in a few cases, but even this may not be sufficient to shelter a country against the competitive forces in the world market. A very interesting case study stems from Malaysia where in the mid-1980s domestic palm oil mills were confronted with increasingly tough anti-water pollution measures. Malaysia supplies eighty per cent of world palm oil exports, but palm oil competes with many other edible oils, so that substitution elasticities are high. The massive effluent problems caused by the industry have been successfully reduced due to the measures. The cost of this operation have mainly been borne by Malaysia's primary producers, the farmers and estates who grow the oil palm fresh fruit bunches. These producers suffered a more than 40 per cent income loss. Compared to other segments of the Malaysian palm oil sector, the primary producers had the lowest price elasticity of supply, so that most of the PPP burden was shifted to their shoulders. In the end, hardly any of the increased production costs were passed on to foreign consumers in the form of a higher supply price (Khalid & Braden 1993).

The preceding case shows the importance of demand and supply characteristics for the possibility to pass on a PPP-caused cost increase to foreign consumers. Whether producers or consumers bear most of the internalised environmental costs ultimately depends on the supply and demand characteristics. With a given supply curve it holds that the share of internalised costs which will be borne by consumers increases the more inelastic the demand curve is, and the lower the substitution elasticity is. With a given demand curve the opposite holds: the more inelastic the supply curve the greater the share which will be borne by producers (e.g. Walter 1975: 96; Dommen 1993: 9). This burden-sharing issue will now be considered for a broader group of primary commodities.

A first crucial factor to look at is whether the price elasticity of overall world demand for primary commodities. Suppose the world market price is indeed increased to such extent that most exporters can internalise environmental costs. Wouldn't internalisation be 'paid for' by an equally large demand fall? Empirical estimates generally find a low price elasticity of *world* demand for most primary commodities (cf. Table 2). The inelastic world demand thus seems to offer ample scope for the internalisation of environmental costs. Price elasticities in the long and medium term are significantly less than one, often in the range between - 0.10 and - 0.35. For non-agricultural

1) In 1988, 202 country shares of a total of 267 country shares in international commodity markets, were below 5 per cent, while in 151 cases it amounted to less than 2 per cent. Only in twenty cases the country share appeared to be 20 per cent or higher (UNCTAD 1992: 228).

Table 2: *Estimates of price elasticities of demand for selected primary export commodities*

Commodity	Import country or country group	Short-term price elasticity	Long-term price elasticities (cumulative)	Substit. elasticity (price subst. commodity)	Source of estimates
Coffee	World	- 0.27			A
	EC	- 0.0677	- 0.107		B
	USA	- 0.396	- 0.396		B
Cocoa	World	- 0.19			A
	North Amer.	- 0.12	- 0.227		C
	Western Eur.	- 0.135	- 0.21		C
Tea	World	0.06			A
	UK	- 0.03			D
	UK	- 0.18			E
	Rest of Eur.	- 0.15			D
	USA	- 0.34			D
	USA			- 0.10 (p/p*)	I @)
Banana	World	- 0.40			A
Pineapple	World	- 2.67			A
Sugar	USA,EC,Japan	- 0.04			O
Jute	Western Eur.	- 0.11	- 0.44		F
	Japan	- 0.18	- 0.35		F
Cotton	EEC-12	- 0.14		+ 0.14 p*(pol.)	G &)
	USA	- 0.30		+ 0.22 p*(pol.)	G &)
Ref.copper	Germany			- 0.24 (p/p*)	H *)
	France		- 0.34	+ 0.55 p*(alu.)	H *)
	USA			- 0.32 (p/p*)	H *)
	World	- 0.30			K
Nat.rubber	World	- 0.20			J
	W.Europe	- 0.13 ^)	- 0.46 ^)		M
Tin	World	- 0.50			K
	Europe	- 0.11/-0.30#)	- 0.41 %)		L
Trop.timber	World	- 0.16 ~)			N
Phosph.rock	USA,EC,Japan	- 0.70			O

Notes: &) Substitute price is polyester fiber staple price; *) Substitute price is price for aluminium; @) Substitute price is coffee price; #) Tin demand for respectively tin-plate use and non-tin-plate use; %) Refers to non-tinplate use; ^) Refers to price elasticities of the market share of natural rubber in total demand for elastomers; ~) Non-conifer logs.
Sources: A) Islam & Subramanian (1989:228-230); B) Akiyama & Duncan (1982a:12); C) Akiyama & Duncan (1982b:14); D) Akiyama & Trivedi (1987:65); E) Ramanujam (1984); F) Thigpen & Akiyima (1986:61); G) Coleman & Thigpen (1991:33); H) Tan (1987:18); I) Chung & Ukpong (1981); J) World Bank (1981b); K) Labys (1980); L) Chhabra, Grilli & Pollak (1981:I-27); M) Grilli, Helterline & Pollak (1981:III-30); N) LEEC (1993); O) Karunasekera (1984).

commodities the elasticity is often somewhat higher, namely in the range between -0.40 and -0.60, depending *inter alia* on the scope for inter-commodity substitution, but these values would still support internalisation of environmental costs.

The main obstacle for an application of full resource pricing to exported primary commodities is the high price elasticity of demand for the exports of *individual* countries. No empirical estimates were found of the price elasticity of commodity demand for *individual* countries. But the empirical importance of the demand effect can be derived along another way. In standard partial equilibrium analysis for competitive markets the demand for individual producers is assumed to be infinitely elastic. At the equilibrium price a producer can sell all his products, but above this price level he is unable to sell anything, because buyers would immediately turn to other producers. If

country *Q* unilaterally increases its export supply price in the market for a homogeneous commodity, this will initially work out as a form of supply rationing, however small. At least a small price reaction will occur. If countries *R,S,T* react to this small price increase by a more than proportional enlargement of their export supply, this will mean that the importers can satisfy their demand for the commodity at a price which is still below the supply price of country *Q*. The price elasticity of demand for the individual export countries will therefore be a function of the sourcing flexibility of the importers and the eagerness with which other exporters will take over another country's market share . Given the homogeneity of most LDC primary export commodities, importing countries can be assumed to be highly flexible in switching between import sources. The competition intensity between exporters can be measured by individual countries' supply elasticities. If the latter are more than unity for at least some competing exporters, it may be expected that the latter will be ready to take over the market share of our country *Q*. Existing empirical estimates support the hypothesis of competitive international markets. The long-term price elasticity of tin supply (worldwide, weighted) amounted to *1.07* according to estimates of Tan, while it amounted to *1.25* and *1.34* for Thailand and Bolivia (1978:16). The long-term cotton acreage elasticity with respect to price changes amounted to *1.80* for developed countries and *0.44* for LDC exporters (Thigpen 1978:10). In a more recent study, the long-run price elasticity of cotton supply was estimated at *1.40* for Argentina and *2.46* for Australia (Coleman & Thigpen 1991: 58). The long-term elasticity of world soybean production with respect to the world market price amounted to *2.75* over the period 1961-1977 (Augusto & Pollak 1981: VI-15). The short-run elasticity of new tea plantings with regard to prices was estimated approximately *0.5* in India and Kenya, but between *1.5* and *2.0* in Sri Lanka and Malawi (Akiyama & Trivedi 1987). The long-term elasticity of jute acreage in India amounted to *1.07* according to estimates of Thigpen & Akiyama (1986). The long-run elasticity of coffee supply was estimated at *1.10* for Brazil and *1.05* for Indonesia (Akiyama & Duncan 1982: 15). For cocoa and rubber the supply elasticities were found to be below unity,[1)] hinting at a less sharp international competition intensity. Another indicator of competition intensity is the supply elasticity with respect to idle capacity. The elasticity of primary copper supply with respect to mine capacity over the period 1964-1983 was estimated to be *1.20* for Chile and *1.10* for Peru (Tan 1987:33).

The fierceness of competition in commodity markets on which LDCs operate, can be explained by objective factors. Many developing countries are highly dependent on

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1) According to Lopriore & Burger (1992:51-58) the one-year lagged elasticity of cocoa supply with respect to producer prices amounted to 0.24-0.65 for the major exporting countries. Akiyama & Duncun (1982: 18) found similar results, both for total cocoa supply and for cocoa acreage. Grilli, Helterline & Pollak's estimates of short-term supply elasticities for rubber were in the range of 0.18-0.25 for all major exporters (1979: 20).

a small number of primary export commodities. These exports are vital for the foreign exchange earnings they need for maintaining their debt servicing capacity, and for secure adequate import levels of essential production inputs, fuels, and sometimes food. Many commodity-dependent LDCs still find themselves in debt problems. Table 3 presents data for a group of 73 LDCs. Debt service ratios are generally highest for the countries which depend most on primary commodity exports.[1] The same link exists between commodity dependence and the incidence of debt rescheduling during a recent three-year period (Table 4). In the latter case oil countries form an exception. Apparently, their 'oil collateral' made restructuring less necessary. The overall link between commodity dependency and debt problems is obviously a very strong one. The direction of causality is open for discussion, but an important factor is certainly that

Table 3: *Debt service ratios in 1990, for a group of 73 LDCs, classified by commodity export dependency*

AVER. SHARE OF PRIMARY COMMO-DITIES IN TOTAL EXPORTS (%), 1985-90	DEBT SERVICE RATIOS IN 1990 (INTREST AND DEBT REPAYMENT AS % OF MERCH.EXPORTS					TOTAL NUMBER OF COUNTRIES
	< 10 %	10-20%	20-30%	30-40%	> 40%	
* > 90%	7	6	5	4	3	25
* 70 - 90 %	2	9	9	2	-	22
* 50 - 70 %	-	5	3	2	-	10
* 30 - 50 %	1	2	4	3	1	11
* 10 - 30 %	-	2	1	-	-	3
* < 10 %	-	1	1	-	-	2

Table 4: *Incidence of debt restructuring in the period 1989-1991, for a group of 73 LDCs, classified by commodity export dependency*

AVER. SHARE OF PRIMARY COMMO-DITIES IN TOTAL EXPORTS (%), 1985-90	INCIDENCE OF DEBT RESTRUCTURING IN 1989-'91 INCL. DEBT CANCELLING (FORGIVEN)			TOTAL NUMBER OF COUNTRIES
	YES	NO		
		NON-OIL CTRY.	OIL CTRY.	
* > 90%	15	5	5	25
* 70 - 90 %	15	4	3	22
* 50 - 70 %	7	3	-	10
* 30 - 50 %	7	4	-	11
* 10 - 30 %	3	-	-	3
* < 10 %	-	2	-	2

Sources Tables 3 and 4: calculated from World Bank, World Tables 1993; World Debt Tables 1992-93; World Develoment Report 1992; IMF, Financial Statistics Yearbook 1992.

1) For another indicator of indebtedness, debt to export ratios, the same picture emerges (cf. Kox 1994: 41).

a long period of low commodity prices increased current account and debt problems.[1] Many countries enlarged their export volume to offset the effect of the deteriorating terms of trade on their foreign exchange earnings, resulting in even more intense international competition.[2] Under these circumstances, any unilateral attempt to internalise substantial environmental costs in international commodity prices will founder due to the strong international competition.

PPP Plus

The 1992 UNCED summit in Rio de Janeiro adopted a common statement in which internalisation of environmental costs was recommended: 'the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment' (UNCED 1992). The preceding pages raised serious doubts about the feasibility of a PPP policy with regard to the main LDC export sector. Adopting such statements, however important, does not even represent a half-way solution. It is too simplistic to take the 1972 agreement between OECD countries as a direct model for the rest of the world community in 1992. Current preconditions are for two distinct reasons essentially different from those which prevailed in 1972 for the OECD countries.

The 1972 agreement was based on the tacit assumption that trade gains and losses by individual countries would by and large cancel each other out, while at the same time all countries would benefit from a better use of environmental resources. As any trade matrix shows, the OECD had and have a high proportion of intra-group trade. In the case of current LDC their intra-group trade as a percentage of their total international trade is smaller. By far the largest LDC export destination is the market of the OECD countries. Here LDCs compete each other with often identical products. Because they trade less amongst each other the scope for trade reciprocity is smaller. Gains and losses of PPP implementation are less easily cancelled out against each other. The fact that LDCs have to compete in a 'third' market makes them much more vulnerable for environmental dumping than individual OECD countries were in 1972. Environmental dumping occurs when some countries try to buy higher market shares by not passing on real natural resource costs or additional PPP-caused production costs

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1) The estimated cumulative loss of commodity export earnings in 1990-'92, due to price changes amounted to US$ 19 billion for all LDCs, which equals 15 per cent of their commodity export earnings. Of the total income loss, US$ 12 billion fell on the American LDCs, and US$ 4.4 bln. fell on African LDCs. These amounts were equal to 21 and 24 per cent of the commodity export earnings of these country groups (UNCTAD 1993: 28).

2) 'Over the last two decades, the traditional structural problems faced by commodity producers and exporters, such as price and earnings instability and relatively slow growth in demand , have been exacerbated by rapidly increasing supplies. The latter stem from increased productivity and the emergence of new and efficient producers, coupled with the inability of inefficient ones to diversify into other economic activities. This has been the case, in particular, for cocoa, vegetable oils and bauxite. For a wide range of commodities exported by developing countries, the expansion in supply has also reflected the pressure to increase exports resulting from the need to service large foreign debts' (UNCTAD 1993: 25).

to foreign buyers.[1)]

A second difference between both sets of countries is that the UNCED countries differ much more in average income levels. With a few exceptions, the OECD countries had comparatively equal development levels. The dispersion of average income levels in the 1992 UNCED group is much wider.[2)] An implication of this income difference is that the welfare consequences of a given PPP policy will differ sharply between countries. The poorer one is, the higher the marginal utility effect of a given income change. For the poor a current income loss due to environmental policy is a disproportionally heavier burden. If these welfare effects are not smoothed somehow, international reciprocity with regard to the internalisation of environmental costs will not easily come about.

Before PPP can become the worldwide standard for internalisation of environmental costs, solutions have to be found for the environmental dumping problem and the differential welfare effect. The latter of both issues received most attention so far. Points 6 and 7 of the Rio Declaration formulate in general terms that the special position of LDCs should be accounted for with regard to the international application of economic instruments and the financial consequences involved. With a few exceptions, among which the Montreal Protocol on ozone-depleting gases, this concern for the special position of LDCs has not yet led to innovative approaches. The importance of the international free ridership issue and the absence of User-Pays complementarity for export goods have so far been underrated.[3)]

If sovereign national governments want to coordinate their actions, they can achieve this via international agreements, in which each country gives up small parts of its sovereign freedom in exchange for other countries doing the same. Intergovernmental agreements create a framework that substitutes for the lack of a supranational regulatory authority. If the environmental problems - and the costs of solving them - are sufficiently general in all commodity-exporting LDCs, they have a common interest to try and start a multilateral initiative. Given the difference between the *global* price elasticity of international commodity demand and that for exports from *individual* countries, there is an obvious opportunity for a co-operative, multilateral

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1) The measurement of environmental dumping is still problematic with poorly developed natural resource accounts in most countries. The dumping concept used here refers to real, but uncounted or uncompensated natural resource costs. It would be wrong to narrow down the concept to compliance costs for environmental policy, since differences in compliance costs would also reflect different natural endowments.

2) The GNP levels per capita (current prices) averaged at US$ 4987 for the 1992 group and US$ 3413 respectively for the 1972 group. The standard deviation of per capita incomes in 1992 amounted to $ 7826, while being only $ 1057 for the 1972 OECD countries.

3) Refreshing exceptions can be found in Dommen (1993); Esty (1994); Andrew (1994); Zarsky (1993). At the same time a 'new orthodoxy' has developed which wants to preclude the use of international environmental co-operation for externalities which do not cross national borders (e.g. Proops et al. 1993) and which ignores the free ridership issue.

approach. If only the 'beggar-thy-neighbour' competition can be overcome through co-ordination, this will allow internalisation of environmental costs without large losses in total demand volume. This is a hope-giving circumstance for international initiatives to make the User-Pays principle work. The developed countries with their concern for environmental dumping, will be interested as well.

A potentially fruitful internalisation approach is the use of voluntary ecolabels to distinguish commodities which have been produced in an environmentally benign way (e.g. Jha et al. 1993). Implementation is however fraught with difficulties (label misuse, limited willingness to pay of consumers, diversity of national standards). For commodity markets it is highly doubtful whether the ecolabels can ever become a widely used instrument, because of the homogeneity of most commodities and because of the fact that most commodities do not directly enter consumption. Another interesting proposal for internalisation is to apply lower import tariffs for goods produced in an environmentally sustainable way (e.g. Zarsky 1993). For primary commodities it is, however, not very practical, because tariffs on primary commodities are alredy close to zero. We will here concentrate on the potential contribution of a third instrument to regulate the issues at hand, vz. International Commodity-Related Environmental Agreements (Kox 1994; 1991).

International Commodity-Related Environmental Agreements (ICREAs)

ICREAs are voluntary agreements between countries to regulate particular aspects of the internalisation of *commodity-specific* environmental externalities. They are designed as co-operative solutions to the international market failure problem with regard to these externalities. ICREAs owe their tongue-breaking name to the desire to differentiate them from most existing international environmental agreements which do not have a commodity-specific character.[1)] Like most other international environmental instrument, they can only complement, and certainly not substitute for environmental policy by governments of commodity-producing countries. ICREAs fully respect the sovereignty of governments in exporting countries, while offering them possibilities to reconcile environmental targets with their macro-economic constraints. Although priority ranking can be subject to negotiation, the basic objectives of this type of agreements are likely to be:

* to temporarily relieve (part of) the international competitive pressures, so that exporting countries can introduce environmental policies in their export sector, without initially losing market share and export earnings;
* effectuate (full) resource pricing for export primary commodities;

1) International Commodity-Related Environmental Agreements must be clearly distinguished from 'old-style' international commodity agreements. The latter aimed at commodity price stabilisation, which is not an objective of ICREAs, even though a stable and rewarding commodity price would probably facilitate the introduction of environmentally sound production methods.

* bring about a transition process towards ecologically sound production methods;
* support governments of the poorer LDCs in shaping an ecological policy towards the commodity export sector.

A fifth objective can be to contribute to export diversification programmes in LDCs where natural preconditions are not fit for producing the commodity in an environmentally sound way, but where a lack of alternative foreign exchange sources would otherwise impede the diversification process.

The ultimate form of an ICREA can be adapted to different market situations, production conditions, and production costs structures. Two basic variants will be mentioned here. The first one is a standard-setting variant. It is an agreement between countries to apply common standards with regard to production technology. The second variant is a transfer ICREA with a financial compensation mechanism. It operates through a compensation fund, fed from agreed contributions from importing countries. In both cases the agreements are created for a particular time period, sufficiently long for the majority of LDC exporters to adopt environmental policies and environmentally preferable production methods. Afterwards, the latter will have become the standard for international cost prices and export prices. From then onwards things can be left to market forces again. In some cases it may be necessary to maintain some form of international monitoring to avoid backsliding to old practices.

Standard-setting ICREA

In a standard-setting agreement exporting countries agree certain technology-related environmental standards for a specific commodity over an agreed-upon transition period. By doing so they can avoid undercutting each other's prices through a continued use of cheaper, but environmentally damaging production methods. An example would be an agreement to ban a particular damaging production method, or an agreement to apply common minimum norms for environmental quality in production regions. The movement towards full resource princing is achieved through the possibility of synchronously introduced sound (but more expensive) new production methods or through synchronously banning old, damaging methods. In either case this will result, all things being equal, in a price jump.[1)]

The exporting countries can conclude a cartel-like agreement, in which the co-operation of importing countries is not required. However, if the cartel coalition is unstable, it might be very helpful to obtain the participation of the main importing countries, because this could help to maintain discipline.

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1) The introduction of the new production methods should avoid to create additional supply stimuli. Otherwise, an excess supply could be evoked which, through short-term price reactions, would hampers the establishment of resource cost-based equilibrium prices.

Transfer type ICREA

The transfer variant is characterised by a different, more direct mechanism for implementing the User Pays Principle. A compensation fund is created from financial contributions by importing countries. The annual contribution of the importing countries is proportional to (a) their net import volume of the commodity, and (b) their per capita income level. The exporting LDCs may draw on this fund for financing projects and programmes which improve the environmental record of the commodity involved. The drawing rights of LDC exporters must be proportional to their export volume. The use of funds may differ between countries, according to their natural preconditions and environmental policy priorities (e.g. erosion abatement, avoiding water pollution by pesticides). In any case it should be in conformity to a funding mandate which is agreed upon by the participating countries. Some monitoring is necessary to secure that proper use is made of the funds. Repeated abuse should result in exclusion from further funds, or even in trade sanctions by importing countries.

The magnitude of the ICREA Fund can be derived by taking incremental costs in a reference country as starting point, or much easier, by a rule-of-the-thumb method, say 3-10 per cent of a trend price.[1] How the import countries collect their contribution for the compensation fund is up to them. Several forms are possible, which differing in the degree to which they effectuate the User Pays principle: a levy on domestic commodity use, contribution from general tax receipts, or even an import levy (provided this is made consistent with GATT/WTO obligations).

Some operational issues

Some general issues are critical to the relevance of ICREAs. The causality links between commodity production and the occurrence of negative environmental impacts must well-established, and must occur rather generally in major commodity-exporting LDCs. Furthermore, domestic government policy should not form the main cause (incentive) for the negative environmental consequences of commodity production. Technological alternatives for current polluting or resource depleting production methods must be available, either in the form of process improvements, or in the form of 'after-process' neutralisation measures. Implementation of the alternative technologies must have a more than trivial consequence for unit costs or government budgets. Otherwise national policy measures can easily be taken without the necessity of international co-ordination. No generalisations are allowed about the cost effect of their implementation, due to the lack of empirical evidence. The available case studies show mixed results (c.f. page 7-8 of this paper). In some cases the increases in operational

1) In some markets with volatile prices the additional user costs may even go unnoticed. The issue of the appropriate size of an ICREA Fund is elaborated on in Kox (1994) which is available from the author on request.

and investment costs are very modest, so that the producers themselves could probably absorb the cost effect. In other cases, like cotton, unit cost increases of thirty per cent and higher were registered. Further empirical studies are necessary here.

The participation issue is particularly important, since this type of agreement aims at finding a way out from the international free ridership problem. ICREAs are agreements between sovereign governments and participation should therefore be based on positive incentives rather than (negative) sanctions). Nonetheless, the risk of free ridership by exporting or importing countries has to be taken into consideration. The following considerations hold for transfer ICREAs. For exporting countries the financial transfers form the most important incentive for participation. A possible incentive for price undercutting by non-participating export countries disappears when the import countries charge the levy on commodity use on a generic basis, i.e. without discriminating for country of origin. It can be necessary in some cases to allow side payments from the Fund for the environmentally most disadvantaged countries, e.g. for export diversification out of this commodity. Non-participation by import countries is discouraged when the export countries charge a higher price for non-participating import countries, with the differential being channelled back to the ICREA Fund. Parallel markets between non-participating import and export countries can only be abated with political pressure, and possibly, with financial pressure and/or trade sanctions.[1] Positive incentives are much more preferable, however.
The participation of importing countries would substantiate the general policy principles which most of them subscribed to in the context of the 1992 UNCED conference. An enlightened self-interest can also bring them to participate, since several transborder externalities - physical and psychological - are involved, certainly in a long-term view. It is beyond doubt that feedback loops exist between the abundance of environmental resources and world market prices (e.g. price levels of tropical timber and many fish varieties). Commodity-importing countries may be better off by now facing a moderate import cost increase instead of huge costs increases in the future.

Appropriateness conditions

Many aspects of the feasibility and appropriateness of ICREAs can only be established on a commodity-by-commodity basis. The importance of in-depth studies for individual commodities has been stressed already. In the absence of empirical studies we per-

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1) The use of trade sanctions against free riders in the context of international environmental agreements (IEA) is subject of intensive debate within the WTO. Some IEA, like the Montreal protocol, the CITES treaty and the Basel Agreement, contain trade sanctions against free riders. The crucial issue is that trade-affecting environmental measures should not be used to cover up 'ordinary' trade protectionism, and should not affect international trade in an unnecessarily restrictive way. A central message from the UNCED conference in Rio was that trade and environment policies should be mutually supportive. Agenda 21 explicitly stated that the accomplishment of "an open, equitable, secure, non-discriminatory and predictable multilateral trading system" would represent a large step in this direction.

formed simulations with a four-country, one commodity model in order to investigate the effects of ICREAs in several ecological and market situations (Kox 1994). Simulations were always run for a period of twenty years. With the proviso that a generalisation of simulation results is always somewhat tricky, the following conclusions were drawn. Standard-setting ICREAs appeared to be most fit when the following (non-additive) conditions prevailed:

* discrete options in the production technology can be discerned;
* low (average) price elasticity of import demand;
* absence of sharp inter-country cost differences for environmentally sound produced commodities;
* governments of exporting countries have an outspoken preference for a clean environment, and are prepared to accept that a limited negative impact on producer profits and government budget is a necessary price for an improved environment.

Appropriateness conditions for the transfer agreements appeared to be less restrictive than those for the standard-setting variant. Transfer agreements can be applied in all cases where standard-setting ICREAs are possible, but also when the following conditions exist:

* import demand is highly price elastic, but the contributions for the Fund are levied in a way that does not have a direct impact on import demand levels, e.g. by the use of general taxes);
* situations where marked inter-country differences exist in costs of sustainable commodity production, but the 'environmentally advantaged' country is prepared to share some of its foreign exchange gains with the disadvantaged country in order to 'buy' participation of the latter;
* the most important importing countries join the agreement, while non-participating import countries are charged a differentiated (higher) supply price by the exporting member-countries.

ICREAs and PPP

One may raise the question whether International Commodity-Related Environmental Agreements are compatible with the intention of the PPP guidelines. Indeed, the guidelines explicitly state that aid to polluters should be avoided, because this would reward wrongdoers and create a false incentive structure. Doesn't the ICREA concept, at least the transfer variant, violate this rule? At first sight it does. We have, however, sketched that application of PPP to vital export sectors is highly unlikely, when it could possibly affect their export earnings. The problem is aggravated by presence of unequal welfare effects, caused by widely diverging per capita incomes. ICREAs seek to deal with this stalemate situation by repairing the 'user-pays complement' of PPP in an international context. They promote the internalisation of environmental externalities

in the prices of internationally traded goods, and hence, create a basis for a more efficient international allocation of trade and resources. In fact this approach represent a form of enhanced PPP or 'PPP Plus'.

The original PPP guidelines explicitly allow for an ICREA-type measures. In a supplementary declaration on the implementation of the PPP the OECD countries agreed that in case of a speedy, sudden or very extensive implementation of environmental policy, environmental improvements may be helped and even speeded up if *existing* polluters are given aid in their initial or transitional efforts to reduce their emissions (OECD 1972, 1974). The aid payments for such purposes should form part of a transitional arrangement for a specified time period, provided they do not lead tot significant distortions in international trade and investment.[1)] The PPP implementation guidelines also state that when steps to protect the environment would jeopardise the social and economic policy objectives of a country or region, e.g. by adding to interregional imbalances or causing unemployment, financial aid to such regions or countries would not run counter the intentions of PPP, again provided that some conditions are met.[2)] Finally, the implementation guidelines state that aid given to promote research and development in pollution control technologies or pollution abatement equipment is not considered inconsistent with PPP. A transfer ICREA could very well financially contribute to such research in the export countries.

Conclusion

Internalisation of environmental costs in the prices of internationally traded goods is increasingly getting attention in world trade negotiations. Indeed, when no cooperative, multilateral solutions are created for this issue, current trends suggest that unilateral solutions will be sought after. These are likely to have the form of protectionist measures to offset the real or imaginary competitive consequences of a difference in environmental compliance costs. The welfare costs of such measures have been sufficiently documented. It is not international trade as such which causes externalities, so there is no reason to suppress trade. Moreover, from an efficiency point of view, it is rather bizarre to request equalisation of environmental compliance costs through trade measures, since the cost differences may very well reflect better or worse natural preconditions for the production of certain goods. It is therefore to be hoped that new

1) The recommendation adds that the conditionality for aid given to new plants should be more stricter even, in order to prevent distortion of competition. In the case of LDC primary exports we could add the concern that such aid could exert an undesired supply incentive.

2) The implementation guidelines recommend that the exceptions are: (a) kept to the level and for the time strictly necessary to reach the specific socio-economic objectives; (b) strictly selective, i.e. they should restrict assistance for pollution control to only those sectors, areas or plants where otherwise severe difficulties would occur; and (c) not creating significant distortions in international trade and investment (OECD 1972, 1974).

co-operative solutions to the internalisation problem for internationally traded goods will come about. The 1992 UNCED summit in Rio de Janeiro called for a worldwide application of the Polluter Pays Principle as a central guideline for the internalisation of environmental costs. It has been shown for the case of LDC primary exports that this recommendation is not even a half-way solution. New international institutions, like for example International Commodity-Related Environmental Agreements, are needed to overcome the remaining difficulties of the transition period and the differential welfare effects. Such new institutions, particularly the transfer type ICREAs, may enable LDC governments to implement now, rather than in a far future, the necessary environmental policies. Technological and financial assistance, vaguely promised in the Rio declaration, is also helpful in building up necessary environmental expertise in LDCs. So far, there is fairly broad disappointment among LDCs and environmentalists about the financial commitments pledged by developed countries. With regard to the primary exports of developing countries International Commodity-Related Environmental Agreements offer a promising way to substantiate the principle that polluters *and* users have to pay for a better environment.

ANNEX: ENVIRONMENTAL EFFECTS OF PRIMARY COMMODITY PRODUCTION

The main environmental externalities of primary commodity production which occur due to the now dominant production technologies, can be described for six commodity groups (tree crops, field crops, livestock, tropical forestry, fishing and mining commodities). The summary is based upon a large number of publications and research findings which for reasons of brevity cannot be mentioned here. Full references can be found in Kox (1994) and Kox, Van der Tak & De Vries (1993).

* *Tree crops*, like coffee, bananas, palm oil, cocoa and rubber often have negative as well as positive environmental consequences. Trees protect soils against eroding, which is especially important in hilly areas. Their shadow is important for water conservation and humidity regulation. Furthermore, trees provide nitrogen-fixing services, a carbon sink function., and a natural habitat for several forms of animal life. Negative environmental effects are linked with ample use of insecticides, fungicides, nematocides and other pesticides. These cause polluted run-off into rivers, lakes and seas, leaching into groundwater, human health damage, and damage to numerous wildlife species. In the construction phase of tree crop plantations large areas are deforested, with strong temporary erosion effects. In some regions nearly all primary forest has been disappeared for tree crop cultivation.

* *Field crops*, like cotton, soya, sugar, tobacco and tapioca, tend to have a much more negative impact on their natural environment. Areas with field crops lose more water due to evaporation and often require irrigation. Erosion damage is widespread and, since harvesting often implies total removal of vegetation, natural replenishment cycles are broken, so that field crops tend to require more input of chemical fertilizers. Intensive use of agrochemicals (biocides, chemical growth regulators, chemical ferti-

lizers) contributes to pollution of the subsoil and surface waters. Some agrochemicals, depending on their application rates and appropriateness for local conditions, cause cumulative long-term effects in the form of pesticide residuals in animal and human food chains and diminishing biodiversity. Use of pesticides is self-propagating, since growing numbers of pests have developed resistance against standard pesticides.

* *Livestock grazing.* Some forms of extensive livestock grazing, particularly pastoralism, can be appropriate and more sustainable forms of land use than cropping, depending on local circumstances and grazing intensity. Forest clearing for extensive farming methods has widely encroached into habitats for wildlife. It can cause fast deterioration of soil qualities. If cattle ranching in arid zones exceeds natural carrying capacities, it disturbs the delicate ecological balance by depleting vegetation and water resources, and by compacting and eroding soils. Intensive farming methods contribute to water and air pollution by nitrate deposits.

* *Tropical forestry.* Massive deforestation in the Amazon region, in South-East Asia and in certain parts of Africa cannot be traced back to a single cause. In some areas, however, the commercial extraction of tropical timber forms a major cause. The direct economic consequences of deforestation are not confined to the depletion of future timber sources. It also diminishes possibilities for non-timber means of existence for the indigenous populations.

* *Mining* tends to have several negative environmental effects. In the excavation and ore removal phase of production the most common problems are: destruction of plant and animal habitat; land subsidence; erosion, silting of lakes and streams; dust pollution; trace metal pollution; giant waste heaps; acid drainage and metal contamination of lakes, streams and groundwater. Open-cast mining contributes heavily to soil erosion by demolition of vegetation and soil structure. In the ore concentration phase of production the most common problems are: waste generation (tailings); organic chemical contamination (residues of chemicals used in concentrators); acid drainage (sulphur in ore) and metal contamination of lakes, streams and groundwater. The smelting and refining phase of production is very energy-intensive, causes air pollution (e.g. emissions of sulphur dioxide, arsenic, lead, cadmium), and generates waste.

* *Fishery.* Overintense fishing of coastal waters and deep sea areas, often by international fishery companies, negatively affects the regeneration capacity of fish populations. Alarming reports have been published recently on the sharp rate of depletion of many popular species both in the tropic and moderate zones. Commercial high-capacity fishing fleets, often with processing facilities on board, roam the world seas to find new species which can be fished as replacement. Even species with very slow regeneration cycles - and therefore vulnerable for extinction - are now being fished. Large quantities of 'by-catch' (less valuable species) are still destroyed without being offered for consumption. Some fishery practices contribute to devastation of the coral reefs and the sea bottom. Intensive fish farming (e.g. shrimp farming) can cause considerable local water pollution and degradation of coastal mangrove forests.

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