Joint Workshop of the International Rubber Study Group and the Secretariat of the United Nations Conference on Trade and Development

on

Opportunities and constraints for the internalization of environmental costs and benefits into the price of rubber

Chairman: Mr M E Cain, Secretary-General, International Rubber Study Group

Session 1: Papers

Chairman's opening remarks

The Chairman welcomed the participants to the Workshop, and expressed his thanks to the Secretariat of the United Nations Conference on Trade and Development (UNCTAD) for their agreement to collaborate in the meeting. He stated that this was the first opportunity for the major players in the rubber industry to consider the subject on which UNCTAD had carried out preliminary studies and which they had identified as an area for further work. He hoped that the views expressed at the Workshop would be helpful to both UNCTAD and the industry in clarifying views and suggesting avenues for future activity. He then read the following message from the Secretary-General of UNCTAD, Mr Rubens Ricupero.

I am very grateful to the Secretary-General of the International Rubber Study Group for convening this joint Workshop as part of the International Rubber Forum. As some of you know, based on several years of conceptual analysis of opportunities and constraints to internalization of environmental costs and benefits in producer prices and their reflection in international prices of commodities and manufactures, the UNCTAD secretariat proposed two years ago the creation of informal sector-specific round tables, in particular for commodities where internalization prospects in the light of product and market specifics are promising. Our analytical and empirical research leads us to believe that one such product is natural and synthetic rubber.

In our view, the round tables should be pragmatic and well-focused forms of dialogue between producers, processors, traders, consumers and interested Governments in producing and consuming countries. They would look at the major environmental problems along the product cycle with a view to internalizing environmental and occupational health costs at the stage where such costs arise. They could also consider – and even in some cases devise – the most suitable and market-specific forms of reflecting due environmental cost increments in international prices of commodities and manufactures. I hope that the present Workshop will usher in a series of round tables that address the rubber industry's specific opportunities and constraints for internalization, allow the industry to take a pro-active approach towards internalization and pave the way to first trials.

Internalization has undoubtedly received much academic attention. Many Governments have endorsed the concept in principle and are committed to discussing suitable experimental ways for turning concept into action. Furthermore, some large enterprises apply various internalization tools for internal accounting purposes in order to address specific environmental problems such as waste minimization. In spite of the wide acceptance of the importance of internalization, however, the use of internalization tools and policies is still in its infancy. This is caused by a variety of considerations, the most important one being concern about loss of competitiveness and foreign exchange earnings in international markets.

Evidence suggests, however, that internalization can increase competitiveness in at least three ways: first, by increasing resource efficiency and/or reducing resource use; second, by limiting waste and pollution and thereby lowering abatement costs; and third, by reducing resource depletion and thereby related environmental costs. It is important in this respect though to harness the synergies between company interests in enhancing resource efficiency and Government interests in allocative efficiency, resource conservation and improvement in environmental quality. Internalization of external costs aims to provide producers, manufacturers and consumers with correct signals as to the true scarcity of resources, including the environmental resources, so that private production and consumption decisions are more in line with the social costs and benefits.

All of you know that environmentally preferable production methods and products exist whose use can be encouraged by internalization. However, there is a lack of sector-specific information on the effects of internalization on production costs and volumes, as well as on other socio-economic variables and export revenues. Furthermore, there is insufficient knowledge on the extent and the most suitable forms of adequate reflection of internalized producer costs in international prices. What is the potential of market-based tools in this respect and to what extent is a regulatory framework required?

As we see it, the basic premise for the Workshop is to make enterprises – and the economy in which they operate – more competitive. It is therefore important to devise the best means to internalize costs and duly reflect them in prices. That requires a better understanding of (i) the optimal level of internalization; (ii) the optimal pace of internalization; and (iii) the preferred instruments of internalization and price reflection. It goes without saying that enterprises that take a pro-active approach towards internalization stand to gain in the competitiveness race. Moreover, most Governments appreciate guidance from industry on the removal of distorting subsidies and the gradual introduction of an internalization-supportive regulatory framework. I would therefore encourage industry to take full advantage of this forum in developing a pro-active approach to internalization.

Globalization of markets and liberalization of national economies, despite some constraints, offer new opportunities for resource and allocative efficiency both in developed and developing countries. Internalization efforts in developing countries, however, might need to be complemented by international co-operation in order to miminize the negative effects of economic and regulatory internalization instruments on export revenues and income.

The UNCTAD secretariat, in collaboration with IRSG and interested academic institutions, stands ready to implement a research agenda, guided by the regular discussion in this forum. Let us remind ourselves, however, that even the best-intended research is not an end in itself;

what counts in this forum is constructive dialogue that gradually allows interested Governments and enterprises to turn concept into action.

Opportunities and constraints for the internalization of environmental costs and benefits: the case of natural and synthetic rubber

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Unless costs and benefits of environmental and health effects are internalized and get reflected in international prices, thorough changes in current production and consumption methods and patterns are unlikely to occur. Investment and consumption decisions, resource use and preservation as well as factor productivity will remain caught by an un-internalized cost paradigm, thus leading to resource and structural inefficiencies. In other words, the most powerful levers of market forces remain unused. These market failures make companies increasingly subject to government regulations and controls which attempt to fill some of the self-regulatory vacuum.

The world rubber economy has a number of environmental problems whose costs are currently not – or only imperfectly – reflected in producer and international rubber goods prices. These problems include: sustainable management of rubber plantations; preservation of biodiversity; effluent problems of rubber processing; the use of non-renewable fossil fuel resources; high energy consumption; and the disposal and recycling of rubber products, in particular used tyres. However, internalization at producer's level could well be turned into a powerful resource-saving and profit-generating tool. This could be the case if internalization were gradually introduced, only being advanced as long as it pays off, and were facilitated by the reflection of 'internalized' producer prices in international rubber goods prices.

For developing countries, in the light of income and foreign exchange constraints, internalization of environmental costs at producer's level would be feasible if increased costs were adequately (*ie* in accordance with the price formation mechanism) reflected in international rubber and rubber goods prices and this price increase did not lead to reduced foreign exchange earnings. Likewise, if 'internalized' producer prices were not adequately mirrored in international rubber and rubber goods prices, international co-operation and assistance would be needed to enable developing countries to implement internalization measures. The resources transferred in various forms through such assistance could be considered to reflect the share of the internalization burden that would fall on the manufacturers and consumers had the producing countries been able to internalize and reflect this in international rubber and rubber goods prices.

A group of researchers at the Free University of Amsterdam, headed by Mr Kox, surveyed 415 specific country-commodity cases on their chances for unilateral internalization by producers. The review first looked at cases where countries had a relatively high share in international commodity markets combined with low dependence on the export of the particular commodity. These would be cases where either opportunities may exist for unilaterally passing on domestic cost increases to international clients, or where the burden of failing to pass on higher producer costs could still be considered bearable. In a second step, cases were eliminated where inter- and intra-commodity substitution (including by synthetic substitutes) was likely to complicate or inhibit internalization. At the end of this analysis, only cocoa and natural rubber remained as promising candidates for unilateral internalization.

We at the UNCTAD secretariat believe that there is sufficient reason to explore fully the possibility of internalization in the case of rubber. We are therefore very grateful to the Secretary-General of IRSG convening this joint Workshop. We also welcome the idea to make the round table on internalization a regular part of the annual International Rubber Forum. What role could be envisaged for this round table?

First of all and as evidenced today, the sectoral round table brings together all players of the price fixing game in national and international markets at almost all levels of the production and processing chain, as well as interested Governments of producing and consuming countries. The forum thus blends private interests in resource economics with public interests in efficient resource allocation and the use of resources in an eco- and health-benign way. Unlike producer cartels, the sectoral round table has the potential to pave the way for a co-operative approach towards the internalization of salient environmental costs along the life cycle of natural and synthetic rubber. At the outset, the round table could identify the priority areas and objectives of internalization, in particular what are the key environmental issues that could be addressed by internalization? These might include issues such as

(a) promotion of sustainably managed rubber plantations;
(b) preservation of a high share of natural rubber in the general elastomer mix;
(c) enhanced development and use of tyres with greater fuel efficiency;
(d) prolonging the treadwear of tyres and thus reducing the frequency of tyre replacement;
(e) promoting the use of retreaded tyres and reclaimed and other forms of recycled rubber; and
(f) making the use of tyre-derived fuel as environmentally sound as possible.

Such prioritization determines the thrust and selection of internalization instruments as well as the constraints that need to be overcome.

By way of illustration, the problems of encouraging the development and use of tyres that allow a higher fuel efficiency and the enhanced re-use and the recycling of used tyres require a different set of internalization instruments. Tyres that reduce fuel consumption on the basis of lower rolling resistance and/or lighter tyre construction materials that significantly reduce tyre weight can, for instance, be encouraged by higher fuel prices and/or tax incentives, for example either within the framework of road taxes or reduced sales taxes on fuel-efficient tyres. Conversely, the disposal problem of tyres could be addressed by a combination of higher disposal charges, Government procurement policies favouring the use of retreaded tyres, and tax incentives for increasing the use of tyre-derived fuel.

The second objective of this sectoral round table could be to assure a holistic approach towards internalization of environmental costs. There is ample evidence that environmentally preferable production and processing methods exist. However, there is a lack of sound knowledge on what the micro- and macro-economic effects and social impact will be of switching towards these methods encouraged by internalization. The round table can thus provide guidance and harness synergies on further conceptual and empirical work on:

(i) the identification of the environmental costs that the various producers are prepared – or will be obliged – to internalize;
(ii) review of suitable issue-specific market-based and regulatory internalization tools and their appropriate mix;

(iii) assessing the effects of internalization on production costs and volumes at various production and processing levels and their impact on socio-economic variables; and
(iv) estimating international trade effects under different internalization and co-operation scenarios.

Third, the round table could initially discuss forms of and limits to internalization based on free-market price-fixing rules. Being confronted with their limits and persistent market failures, the round table could devise desirable forms of Government regulation in producing and consuming countries. In addition, it could address forms of financial and technical assistance to producers and manufacturers, particularly in developing countries, who are interested in cost internalization but reluctant to practice it unilaterally. This reluctance would arise from the risk of non-recognition or non-reflection of 'internalized producer costs' in international rubber and rubber goods prices. In this regard, it needs to be borne in mind that the countries in East, Southeast and South Asia have become the world's most important rubber consuming area and that this region is and will be at the centre of attention among tyre makers, suppliers and customers and attracts the majority of tyre and vehicle industry investments, with about half of the expansions announced world-wide in the recent past.

Finally, the round table might be a useful interlocutor for other international fora trying to translate into practice forms of internalization of environmental benefits in the context of containing the growth of greenhouse gas emissions. The UN Framework Convention on Climate Change, for instance, initiated a pilot phase of so-called activities implemented jointly aimed at reducing carbon emissions and protecting carbon sinks. The activities implemented jointly bring together countries with varying degrees of development where the more developed country invests in more cost-effective projects of emission reduction and increased carbon sequestration in a developing nation to meet a self-imposed carbon emissions target. At the moment, 32 projects in this regard are considered that, *inter alia*, include energy efficiency, forest preservation and reforestation.

The activities implemented jointly provide several opportunities for obtaining financial assistance for switching towards environmentally friendly products or production methods in the world rubber economy. This concerns, for instance, reforestation projects of rubber trees. Estimates suggest that one hectare of natural rubber trees fixes about 10–12 tonnes of carbon annually.[1] Rubber plantations are therefore a potentially very interesting case for activities implemented jointly. The thus-obtained financial support would make natural rubber much more competitive in the world elastomer market. It is also conceivable that within the framework of activities implemented jointly one could support the development and use of fuel-efficient tyres in some developing countries.

Some priority areas of internationalization

Promotion of sustainably managed rubber plantations.
- Preservation of a high share of natural rubber in the general elastomer mix.
- Enhanced development and use of tyres with greater fuel efficiency.
- Prolonging the treadwear of tyres and thus reducing the frequency of tyre replacement.
- Promoting the use of retreaded tyres and reclaimed and other forms of recycled rubber.
- Making the use of tyre-derived fuel as environmentally sound as possible.

Further direction of conceptual and empirical work

- If applicable, identification of the environmental costs that the various producers are prepared – or will be obliged – to internalize.
- Review of the suitable issue-specific market-based and regulatory internalization tools and their approximate mix.
- Assessing the effects of internalization on production costs and volumes at various production and processing levels and their impact on socio-economic variables.
- Estimating international trade effects under different internalization and co-operation scenarios.

Reference

1. Sethuraj, M.R., The impact of natural rubber plantations on the environment, *Proc. of the international seminar on natural rubber: an eco-friendly material*, Trivandrum, India, September 1996.

Rubber and the environment

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Introduction

One key factor in the relationship between any activity and the environment is that it is impossible to consider any individual activity without reference to the overall consequences; nevertheless, it is useful to introduce a taxonomy. In the case of the rubber industry it is helpful to break down the activities which impinge upon the environment (Table 1) into those associated with (1) the production of the raw material, (2) the transformation of the raw material into finished products, (3) the use of such products in service, and (4) the final recycling or disposal of the products. Many studies relating to the last-named, such as investigations of the scrap tyre problem, fail to recognize the importance of the other elements which may either amplify or mitigate the problem. It is inevitable that the author tends to base his analysis upon natural rubber, frequently in comparison with synthetic rubber, but many of the factors (such as factory emissions, product service and ultimate disposal) apply to all elastomers.

In most discussions on the environment, resources are divided into renewable and non-renewable categories. The former includes most natural products. The latter includes most mineral resources, although many of these are recyclable, and fossil fuels. The Scandinavians tend to consider their large hydroelectric capacity as a green resource. Fossil fuels are not only non-renewable, but their combustion contributes to increases in global carbon dioxide levels and a possible greenhouse effect which may lead to higher ocean levels and the loss of global land mass.

Table 1: Taxonomy of environmental consequences of rubber usage

Stage	**1**	**2**	**3**	**4**
	Production of raw material	**transformation** into finished products	use of products **in service**	final product **disposal**/ recycling
Benefits	CO_2 sink (NR) timber land conservation employment	Employment	reduce noise reduce vibration energy transfer contain liquids..	fuel source “raw materials”
Damage	Water pollution	odour pollution peak power loads	air pollution water pollution traffic congestion noise	land loss pollution

Raw material

Natural rubber is an unusual industrial material as it is a renewable resource. As such, natural rubber enjoys very considerable environmental benefits, and these have tended to be understated in most previous discussions. Tables 2 and 3 indicate how in broad energy input terms natural rubber enjoys a very considerable advantage over synthetic elastomers. The data upon which the Tables were based[1] are now rather old and it is probable that the synthetic rubber industry has reduced its energy inputs for processing and that the use of yield stimulation may marginally increase the energy consumed in natural rubber production. Nevertheless, the natural rubber production data (Table 2) assumed long-distance transportation for the raw rubber from the producing countries to the then major consumers. Since then there has been a significant shift in rubber product manufacturing to the natural rubber producing countries and this will have marginally reduced energy inputs, although these will have been balanced (except in the case of latex goods) by increased energy costs for the transport of manufactured goods. In the case of latex goods the non-transport of water around the world must represent a very considerable environmental gain.

Table 2: Energy inputs for natural rubber production, GJ/tonne.

Fertilisers and other chemicals	5
Primary processing	3
Transport	5–8
Total	15–16

Table 3: Energy content of some synthetic rubbers.

Material	Energy consumption, GJ/tonne	
Polychloroprene	144	120
SBR	156	130
Polybutadiene		108
EPDM	170	142
Polyurethane	209	174
Butyl rubber	209	174
Polypropylene		110

In these earlier studies, no allowance was made for *Hevea* being a significant source of timber. The use of rubberwood is growing rapidly and *Hevea* is even being grown primarily as a source of timber, with rubber being produced as a by-product. Rubberwood is used in furniture, flooring, building components, chipboard, *etc* and enjoys a growing market, especially in the United Kingdom. Obviously, the timber so-produced is an eco-friendly material and it is highly pertinent to note that some of the companies involved are subjecting rubberwood production to environmental audits.[2] It has been estimated[3] that the energy input for wood as a raw material is about 6GJ/tonne as compared with 38GJ/tonne for steel and around 100GJ/tonne for most thermoplastics.

The most understated aspect of *Hevea* cultivation is that of a sink for the carbon dioxide which is produced by animals (including man), the natural combustion of plant tissue, and especially through the burning of fossil fuels. Photosynthesis enables the carbon dioxide to be converted into life-sustaining oxygen whilst fixing the carbon as biomass. Hevea's effectiveness in this respect is probably at least equal to that of virgin forest and may even exceed it. Wan Rahaman[4] states that tropical forests, which cover 20 per cent of the earth's surface, account for at least 25 per cent of global terrestrial carbon fixation, and it is becoming increasingly recognized that the equatorial forest makes a major contribution to global ecology: President Clinton reasserted this when visiting Costa Rica recently.[5]

Hevea compares well with virgin jungle[4] in terms of biomass, especially once the trees reach maturity (Table 4). Physiological studies[6] have shown that *Hevea* is more effective than teak grown in plantation conditions in taking up carbon dioxide. This is probably due to the extra energy required to produce the latex inside the tree: thus, in contrast to a synthetic rubber plant, which consumes energy and produces carbon dioxide to convert pure energy (crude oil) into elastomers, the natural rubber plant converts carbon dioxide into an elastomer. The biomass production potential[6] of a plant species is related to its photosynthetic capacity per unit leaf area and the total leaf area produced per plant. In full sunlight the photosynthetic rate of a mature rubber leaf is around 11μmol/m^2/s^1 as compared with 5–13μmol/m^2/s^1 in other tree species (Table 5). The leaf area produced by a mature rubber tree is quite substantial: the leaf area index of a mature rubber plantation can be as high as 6 or 7. Because of the high photosynthetic rate and leaf area index the biomass production per unit land area within a given time is very high in *Hevea*. With a planting density of 450 trees per hectare the canopy closes in less than five years.

Table 4: Biomass of *Hevea* versus tropical rain forest.

Ecosystem	Biomass dry weight, tonnes/ha
Humid tropical evergreen forest	
Malaysia: Pasoh	475–664
Malaysia: Mulua	210–650
Brazil: Manaus	473
Hevea rubber plantations	
Eleven years	206
Twenty-four years	248
Thirty-three years	445
Thirty-three years (untapped)	963

Table 5: *Hevea* – biomass conversion.

Function	Hevea	Other tree species	Other crops	Unit
Photosynthetic rate	11	5–13		μ mol/m^2/s^1
Biomass	200–450	300–650		tonnes/ha
Untapped	950			tonnes/ha
Nutrient efficiency				
N requirement	30			kg/year
			100	each kg/year
P/K requirement	30			each kg/year

Table 6: Nutrient removal of different crops via yield.

Crop	Yield, kg/ha	Nutrient removal, kg/ha			
		N	P	K	Mg
Rubber	1800	17.8	3.6	14.5	3.6
Tea	1300	60.0	5.0	30.0	4.8
Coconut	1400	62.0	17.0	56.0	16.5
Oil palm	2500	162.0	30.0	217.0	30.0

Natural rubber does not impoverish the land upon which it is grown (Tables 5 and 6).[6,7] Fertilizer inputs are very low and the surrounding soil appears to be enriched by the abundant leaf fall. Furthermore, biodiversity remains remarkably high in rubber plantations (Table 7), in marked contrast to most forms of monoculture.[8] Excellent agronomic techniques assist in the conservation of the environment within rubber plantations. Measures include terracing, silt pitting and bunding and the growth of leguminous cover plants between the rows to assist with nitrogen fixation.[4] Biomass burning is discouraged during replanting. Moreover, it is possible to grow a wide variety of crops during the tree's immature period, further enhancing its environmental credentials.

Table 7: *Hevea* – biodiversity.

	Hevea plantation	Teak/jerul plantation	Natural jungle
Small invertebrates	35	7–8	15
Flora	35	na	12

It is possible to produce dry rubber with remarkably low energy inputs, especially if maximum use is made of human and solar energy. It is possible to produce air-dried sheet solely by the exploitation of these two forms of energy. Most dry rubber and latex concentrate production does exploit modest inputs of electricity (which in many producing countries is green power from hydro generators) and from kerosene for drying.

Unfortunately, primary processing of natural rubber can lead to significant environmental pollution, especially of watercourses and through localized unpleasant odours. Considerable progress has been made in reducing water-borne pollution, especially in India, Malaysia and Sri Lanka, but in many countries a considerable problem remains. This endangers many other activities, such as the use of water for agriculture, for industrial use and for fish cultivation.

Processing

Obviously energy is required to transform dry rubber into a form where it can be shaped and vulcanized. Some work has been performed to eliminate this step: including some which formed a part of UNIDO-funded IRRDB Projects. There are three major alternatives: liquid, powder, and thermoplastic forms.[9] Neither of the first two forms has made much progress, mainly because the properties achieved in the final end products are inadequate, especially in relationship to the increased cost of the raw material. Either it is possible to use alternative materials which achieve better properties, or (especially in the case of powdered natural rubber) traditional processing methods are fully able to compete against the higher cost/poorer property profile of the modified rubbers.

There was considerable interest in powdered rubber during the Energy Crisis and there were several forecasts[10,11] which considered that 20 per cent, or even more, of rubber would be supplied in this form by 1990. Allen[9] showed that there is a severe cost penalty associated with the preparation of powdered rubber, and it is highly probable that this financial debit could be translated into environmental terms. The use of bromination and/or talc to separate the rubber particles could scarcely be regarded as an environmental gain. Furthermore, both liquid and powdered forms require energy inputs to achieve this form and it is questionable whether these are substantially less than that required for mastication and mixing.

Thermoplastic natural rubber is difficult to evaluate in energy terms: the main aim of the material has been to increase labour productivity and to enable an elastomeric material to be used within a different manufacturing environment, namely that of the thermoplastics processor. In the case of natural rubber, thermoplasticity is achieved through the incorporation of a thermoplastic material, typically polyethylene or polypropylene. In environmental terms, thermoplasticity is attained at the cost of incorporating a higher energy (approximately tenfold more energy intensive) material. The ability to recycle thermoplastic rubbers, and especially processing waste, is obviously a major environmental gain and will recover some of the extra expenditure in non-renewable materials.

The energy requirements for dry rubber processing are in the region of 20–30GJ per tonne: this includes overheads such as factory lighting. In 1976 the then US 'Big Five' consumed 31GJ per tonne and at that time the energy inputs[12] into some of the individual operations are shown in Table 8. There has been a substantial reduction in the energy requirements since then, but the relativities probably still hold. Vera and Kovac[13] claim a 25% reduction in the energy required for tyre manufacture since the late 1970s, mainly through the use of more energy-efficient equipment, computerized control and the recycling of waste heat.

Table 8: Energy requirements for processing, GJ/tonne.

Banbury	4.1
Calender	6.6
Extruder	3.8
Curing	6.3

Natural rubber does appear to be slightly less energy-friendly at the mastication and mixing stages than its synthetic counterparts. This is due to several factors. Firstly, raw natural rubber tends to crystallize in storage, especially at low ambient temperatures. It is, therefore, necessary to thaw natural rubber in hot rooms (40–45°C) in northern latitudes in winter. It is estimated that the energy cost for this treatment is in the region of 100MJ per tonne if the period required for thawing is four days.[14] Secondly, the energy required for mastication and mixing is slightly higher than for most synthetics, especially where these are supplied as oil-extended masterbatches. Work at MRPRA estimated that natural rubber requires about 1.2GJ/tonne for mastication and 2.9GJ/tonne for mixing.[1] Nevertheless, the additional energy required to process natural rubber is far less than the difference between the energy requirements for the more efficient processors and their less efficient rivals. Moreover, the overall energy requirements for rubber processing (of 20GJ/tonne, or lower in Scandinavia) are considerably less than the initial energy inputs for manufacturing synthetic elastomers.

Mixing natural rubber can lead to the emission of unpleasant odours and this can become a serious problem in urban areas. The greatest problem is associated with the use of low-grade rubbers, especially those with high protein contents, such as skim rubber. The use of SMR CV, and similar grades, can greatly alleviate the problem.[15]

Some of the materials which are incorporated within rubber to achieve vulcanization, to provide protection against oxidation and other environmental factors (such as ozone) and to achieve greater stiffness (such as carbon black) may lead to problems in the working environment and in adjacent areas. They may also be liable to cause hazards during transportation. Most, especially carbon black, represent high energy inputs. Natural rubber may require greater protection from oxidation than its synthetic competitors and this may be perceived as an environmental debit, although one which is difficult to quantify. Blends of natural rubber with ageing-resistant synthetics, such as EPDM, are one means of overcoming this problem.[16]

Until recently, the manufacture of rubber-to-metal bonded components, many of which are used in engineering applications, has involved the use of solvent-based adhesives. Such solvents are associated with health problems and there is increasing pressure to eliminate their use and to replace them with aqueous systems. Considerable progress is being made to eliminate them: and it is expected that 25 per cent of natural rubber bonding to metal can now be performed in this way. It is not yet possible to bond polychloroprene in this manner, and this gives natural rubber an environmental edge in this type of outlet.[17]

In service

There are both positive and negative environmental factors in the in-service segment of an elastomeric product life cycle. The positive factors include a reduction in environmental noise, although tyre noise is a major contributor to environmental disturbance from roads, especially where vehicles travel at high speed. A clear positive contribution to noise and vibration control is to be found in the application of elastomeric mountings and bearings. These can either be used to isolate some vector such as lift motors, power hammers, *etc*, or can be exploited to keep a building, or part of a building, free from external disturbance. Examples of such applications include the isolation of sensitive buildings, such as concert halls, from extraneous noise and vibration and the construction of buildings in close proximity to major sources of disturbance, such as underground railways. In practice, many applications of rubber in mechanical engineering cover both aspects: car engine mounts not only enhance passenger comfort, but also contribute to reducing noise pollution within the environment. Similar arguments can be applied to rubber flooring, weatherstrip in cars, and so on.

In many applications, the low weight of elastomeric components in comparison with comparable metallic components is sometimes ignored. This is especially important in springs. Engine mountings have been mentioned already. The suspension units, especially air springs, used in railway rolling stock are considerably lighter than the more traditional metallic springs. This reduces the weight of the vehicles and reduces the power demand: this is especially important on underground railways where the heat generated from powering the trains may have to be removed by fans.

The negative factor, for it is essentially one, is that the main outlet for rubber is in association with the automotive industry. The road transport industry accounts for a disproportionate uptake of the world's natural resources. In the USA, approaching 25 per cent of crude oil is consumed in personal transportation. This industry is a major contributor to global increases in carbon dioxide emissions and endangers health, especially that of children, through asthma and other dangers. It must be stressed that these effects are not directly associated with the use of rubber, but that the system which induces them is inherently dependent upon rubber for its tyres, its engine mounts, its weatherstrip, and so on. Table 9, which is based upon data provided by Dufton,[17] illuminates this aspect of the product life cycle, where it is seen that the energy required to manufacture or dispose of a passenger car tyre is trivial in proportion to that associated with its use in service.

Table 9: Energy usage per passenger tyre.

Stage	Litres oil equivalent
Manufacture	20
Retread	8
Run (one tread)	5,000–10,000
Release as heat	41
Granulate	61

Another, lesser, negative factor is that rubber components, especially tyres, tend to wear in service. This leads to the emission of particulate material into the environment. There have been some dubious suggestions[19] that such particulate material may contain latex proteins and that this could produce allergic responses in susceptible individuals. Presumably, some of the airborne fragments could combine with the exhaust gases emitted by vehicles to contribute to the unpleasant urban smog which is found where the pollution is trapped either within an

inversion layer and/or within a confined environment. There has also been some suggestion that tyre particles could lead to waterborne pollution in rivers and lakes.

Kovac[20] argued that private transport as represented by the automobile 'personifies a free society and the pursuit of happiness'. As long ago as 1935, J.B. Priestly[21] wrote 'away from the arterial roads, there are still bright tracts of earthly paradise' when referring to the British countryside. Yet the same writer was ready to exploit the motor car for his travels in preference to the railway train which he regarded as outmoded even then. There would appear to be two problems. The first is that the American system of almost unfettered reliance upon personal transportation is inappropriate for the more densely populated European countries and for urban areas elsewhere. The second is the still to be fulfilled basic need for better roads and suitable vehicles to decrease the reliance upon local resources in rural Africa, China and elsewhere. This would reduce the effects of famine through crop failure, disease and natural disaster.

The need for physical travel will be reduced by the general availability of modern methods of telecommunication and increases in computing power. As is so often the case with global problems, solutions are found just when the problem appears to be becoming insurmountable. Working at home is increasing and this will go some way towards resolving the problem for some people of commuting by road. People may learn to make less use of their personal vehicles and make greater use of public transport. The United Kingdom's Royal Commission on Transport and the Environment[22] considers that human attitudes will have to be changed towards public transport. Obviously, if this happens there will be a decrease in the demand for elastomers, especially in the traditional western markets, but this will be offset by uptake in the areas which really need road vehicles to survive – to avoid localized famine and disease and to provide relief from natural disasters.

Amelioration

Clearly, if the tyre is taken more or less in isolation then a very different picture emerges. Perhaps this is easiest to perceive if the pneumatic tyre is taken from its normal environment and transferred to an alien one, such as the Paris Metro system, where some of its key assets become clearly discernible. Some of the Metro lines are not in tunnels, but on viaducts along the middle of the street: in such locations the advantages of the pneumatic tyre are self-evident in the lack of clatter which normally surrounds an elevated railway, such as the Chicago Loop or the long-defunct Liverpool Overhead Railway. Furthermore, the passenger enjoys a smoother ride, at least on straight track, and a faster transit due to the higher rate of acceleration. On the other hand this gain is purchased at a cost, such as the increase in heat generation and the more complex track which is required. Table 10 attempts to show the balance for some of these factors.

Table 10: Rubber-tyred Metro systems.

Benefits
Quieter than steel wheels
More rapid acceleration/deceleration
Smoother ride (straight track)
Disadvantages
More complex (two track systems)
Extra heat to dissipate
Difficult to apply to existing railways
Not compatible with rail technology

A broader analysis of the environmental benefits of the tyre is shown in Table 11 together with some of the main problems which still remain. In some cases there is a balance: tyres may produce a quiet and smooth environment for the occupants of the vehicle yet may still be a major source of noise pollution for those who reside near high-speed roads. Smoother tyres which would lessen the environmental noise problem would be less safe as they would provide less grip, especially in the wet. In many cases, lower speed limits would produce considerable environmental gains. Clearly, the problem of tyre disposal must be tackled if progress is to be made.

Table 11. Tyres: environmental balance.

Benefits	Disadvantages
Quietness of ride	Noise (external)
Smoothness of ride	
Braking/acceleration/cornering	Rolling resistance (= fuel consumption)
	Particulate pollution
Prolong track life	Environmental damage (fumes...)
Safety	Traffic accidents
	Disposal

Many commentators, including Vera and Kovac,[13] place considerable emphasis upon the reduction of rolling resistance as a means towards reducing vehicle fuel consumption and exhaust emissions. A fully loaded truck needs only a 2–4% reduction in rolling resistance to save 1% in fuel. For cars a greater reduction in tyre rolling resistance (5–7%) is needed for comparable fuel economy. Lower rolling resistance can be achieved through care in design, reduced weight, the substitution of silica for carbon black, and most simply, through ensuring correct tyre inflation.

Product life extension

Product life extension is an important contributor to lessening the environmental impact of any activity. This can either be achieved by extending the life of individual components, or through prolonging the life of the system in which they are situated, or both. In some cases it may be possible to prolong product life through reconstruction once or more during the life cycle – an excellent example of this is the multiple retreading of aircraft tyres. The automotive industry demands that products should, as far as possible, last for the entire life of the vehicle and this has greatly affected the character of many elastomeric components. At one time cautious motorists used to carry spare fan belts and even radiator hose as it was anticipated that there was a reasonable probability of failure. Such caution is no longer required. Hose and belts last the life of a vehicle unless some catastrophe occurs. Wiper blades and tyres are still changed, but at decreasing intervals.

Banchieri and Mowdood[23] predict that car tyres will last for the life of the vehicle within the decade 2010–2019 and that truck tyres will have 2,400,000-km casings. These forecasts are probably sufficiently far over the horizon to be no more than wishful thinking. Nevertheless, some progress[24] is being made towards increasing tyre life (Table 12).

Careful design of tyres can save weight and reduce fuel consumption[25] and thus produce marginal improvements in what is an extremely wasteful system. Similar enhancements *could* be achieved by reduced speed limits. Such measures would also reduce pollution and

would marginally increase road capacity. Reduced speed limits would also encourage the use of other less wasteful transport modes such as rail.

Table 12. Tyre performance index

1960	100	cross-ply
1965	200	radial
1990	320	second generation
2001	360	

Retreading

An increase in retreading activity would probably be the greatest contribution which could be made by the tyre industry. At present there is far greater retreading activity in truck tyres, especially in North America, than in passenger tyres, and as noted aircraft tyres are routinely retreaded many times (eight appears to be about the norm for airliners). The lack of a vigorous retreading industry for passenger tyres stems from (1) the great variety of sizes and styles of original equipment, (2) the relatively low carcass strength (which partially reflects the quest for lower weight to reduce fuel consumption), and (3) the dangerous tendency for car drivers to use tyres to beyond the point at which they are retreadable – and safe. There is also a lack of the strong infrastructure which enables road haulage companies to have their tyres serviced on a routine basis: this infrastructure enables retreading to be performed as part of a tyre supply operation. Clearly, it is impossible to envisage such an operation for private cars, unless government regulation and standardization are imposed. Such an imposition would have the benefit of discouraging motorists to drive with tyres which are no longer fit for service.

Most governments continue to pronounce that it is desirable to increase retreading activity. There is some indication that modest increases are taking place, but a more general increase probably requires major social and minor technological changes. As noted earlier the whole question of private versus public transport is a thoroughly emotive issue in most developed countries: retreading is only a minor contributing factor when compared with the overall problem.

Recycling

A few elastomeric products are disposable, especially those manufactured from latex (gloves and balloons, for instance). In the case of balloons these will naturally degrade within about a month if left upon the ground. Unfortunately, medical gloves have to be burned alongside other disposable medical items to eliminate the pathogens which may be present.

Elastomers are difficult to recycle. The problem can be eased through the use of thermoplastic elastomers, although damage in service (especially through exposure to fuels and the combustion products from fuels) may lessen the value of such materials to a point below which it is valid to expend the effort required for recycling. It is possible to reclaim rubber, but this industry is only exploited on a large scale in India (Figure 1) where there is a plentiful supply of labour and the demand for elastomeric raw materials greatly exceeds the supply.

More recent recycling methods, such as *De-Link, Surcrumb*, and *Tirecycle*, can make a contribution to reducing factory waste, but are unlikely to be able to resolve the ‘scrap tyre

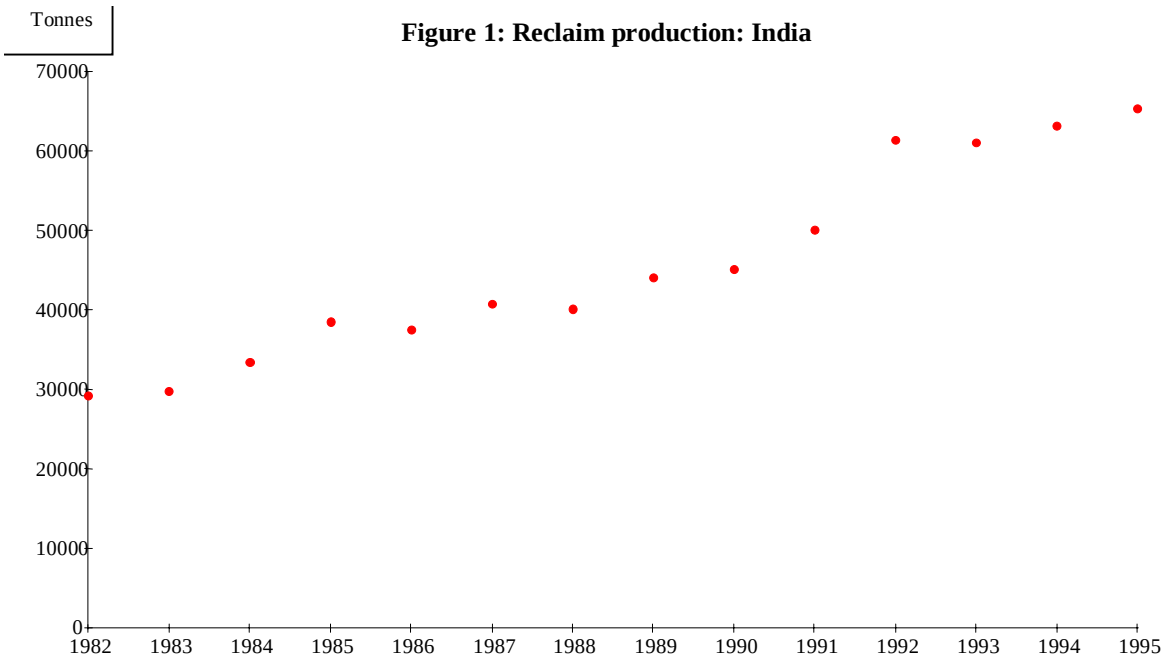

Figure 1: Reclaim production: India

problem'. Re-use of tyres in their basic form can contribute little to the problem: furthermore, the bulk of the material remains as a problem at some subsequent time. Crumb rubber produced from tyres (especially from retreading operations) is beginning to find a growing market in a variety of outlets, mainly in safety paving.

It must not be forgotten that the crumbing of scrap rubber, especially tyres, is an energy-intensive operation (Table 13). Apslund's data[26] show that chopping a tyre into large pieces for transport is a worthwhile process in terms of energy expenditure, but that the production of fine particles may be difficult to justify unless an environmentally worthwhile outlet can be found (such as children's play areas). This may not be as wasteful if the material is a non-renewable resource, such as a typical synthetic elastomer, but may be more difficult to justify for natural rubber. Furthermore, it should be remembered that all reclaiming methods require the reduction of the input into relatively fine granules.

Table 13. Energy consumption – shredding and grinding, MJ/tyre.

Large pieces	0.5
5-cm x 5-cm pieces	2.5
2.5-cm x 2.5-cm pieces	16
Granules, 0.6–1.2 cm	40-50
Cryogenically ground crumb	100

Crumb rubber is being used as a replacement for stone in highway drainage systems as it is much safer (there is no risk of damage to windscreens from the displaced drainage material). There was widespread interest in its use as a form of filler for asphalt in road pavements, especially in the USA, but there appear to be doubts about the effectiveness of this technique, despite a long use of raw elastomers in roadworks. Unfortunately, there is even some evidence that the presence of tyre crumb may make it more difficult to recycle asphalt pavings (which is in itself a resource-saving operation). This is a pity because there is something attractive in the concept of using old tyres as part of the surface upon which they run!

The best means for the disposal of old tyres appears to be pyrolysis or straight combustion, with power generation and/or local space heating being the secondary or primary products – this is a view with which Vera and Kovac[13] concur. Straight combustion appears to be especially attractive when associated with Portland cement manufacture, as the sulphur serves to reduce the alkalinity of the exhaust emissions and the steel contributes to the strength of the concrete. Uptake of scrap tyres by the cement industry varies greatly from country to country. It appears to be a major outlet in Germany, where it competes with brown coal, and in Japan which has a shortage of fossil fuels. In general it has to compete with low-grade fuels, such as coal and petroleum coke, but it does enjoy a comparable energy value as fuel.

There is a problem of exhaust gas scrubbing in straight combustion, mainly to remove the sulphurous gases, although it must be remembered that the carbon dioxide produced is not a problem for the natural rubber element of the tyres as this will be recycled by the rubber trees that produced it in the same way that it is possible to grow biomass as a source of fuel. Pyrolysis is an interesting possibility as there is no air pollution problem and the products, other than heat, are in the form of gases (which can be burned), solids and liquids (which should be combustible if no other market can be found). The solids include a form of carbon black, which if the input consists predominantly of natural rubber, can be claimed to be 'green': Table 14 shows the main products from a nearly-commercial pyrolysis system.[27] The main difficulty would appear to be economics.

Table 14. Pyrolysis plant – recovered products.
Capacity – 75,000 tonnes/year

Product	Yield, tonnes/year
Oil (30%)	22,500
Gas (20%)	15,000
Carbon (40%)	30,000
Steel (10%)	7,500

Conclusion

There is a growing recognition that the global ecosystem cannot continue to tolerate the present wasteful use of materials. The rubber industry is fortunate in that over one third of its key raw material is based upon a self-sustaining resource which is not only capable of re-absorbing the carbon dioxide generated from its disposal and through its use, but also provides timber as a valuable, environmentally-friendly by-product. The natural rubber industry is based upon minimal environmental disturbance, and is far less than that required to produce typical food crops. Nevertheless, it cannot be forgotten that the primary end use is in association with personal transportation, much of which is extremely wasteful in terms of global resources.

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Session 2: Panel discussion

The Chairman introduced the Panel, comprising:

Dr U Hoffmann, *UNCTAD*
Mr K P Jones, *IRRDB*
Mr H L M Kox, *Economic and Social Institute, Free University, Amsterdam*
Mrs J Lalithambika, *Association of Natural Rubber Producing Countries*
Dr Wan Abdul Rahaman, *Rubber Research Institute of Malaysia*
Mr I K Yeboah, *Professional Association of Natural Rubber in Africa*

The last four were invited to make brief statements on the theme outlined by Dr Hoffmann.

Henk L.M. Kox, *Economic and Social Institute, Free University, Amsterdam, Netherlands*

I would like to begin with some definitions:

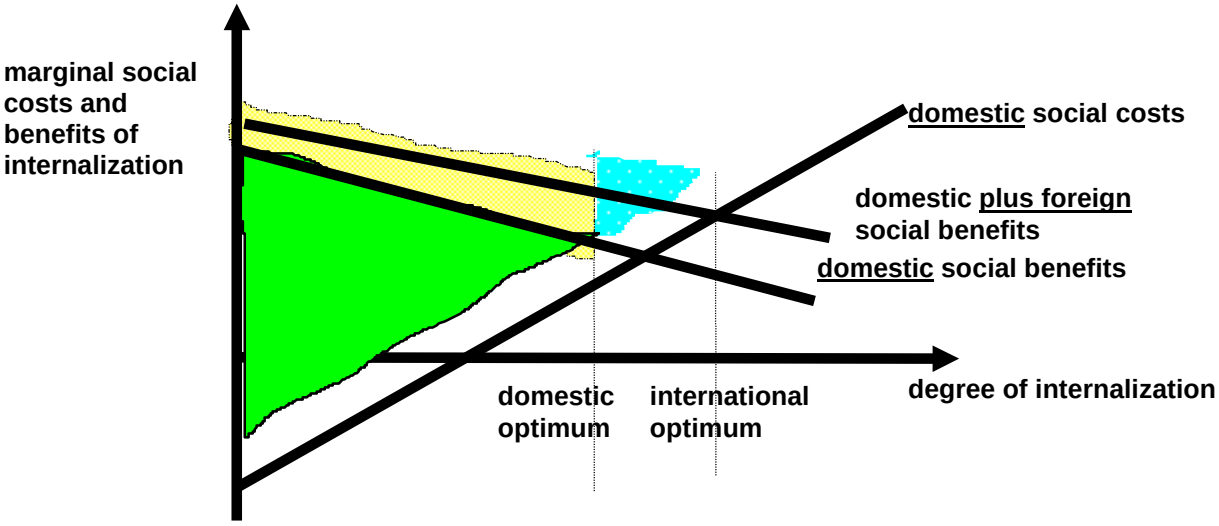
Environmental externalities are those environmental impacts of production and consumption activities which cause ***uncompensated costs or benefits to other parties.*** 'Other parties' may be private or public, current or future, domestic or abroad.

Internalisation refers to all measures (public or private) to ensure that those uncompensated costs or benefits become ***reflected in the prices of commercial goods and services***. After internalization, prices become better signalling devices with regard to social preferences. It improves the social functioning of markets and private initiative.

Degrees of internalization. Internalization policy is not a binary choice. There can be degrees of internalization. Internalization policy depends on ***trade-offs between social costs and benefits*** of environmental measures. Trade-offs may exist, *eg* between a clean environment and gainful employment, or between high environmental quality and export earnings. Optimal environmental policy proceeds with internalization until the marginal social costs and benefits of the measure are equal.

Level at which action should be taken. The proper level at which internalization action is to be taken depends on the ***geographical scope*** of the environmental externalities**.** It appears that most externalities are properly dealt with at **national** level or even at a **regional** level. For externalities which pass national borders, **international** co-operation is required in order to maximize anyone's net benefits.

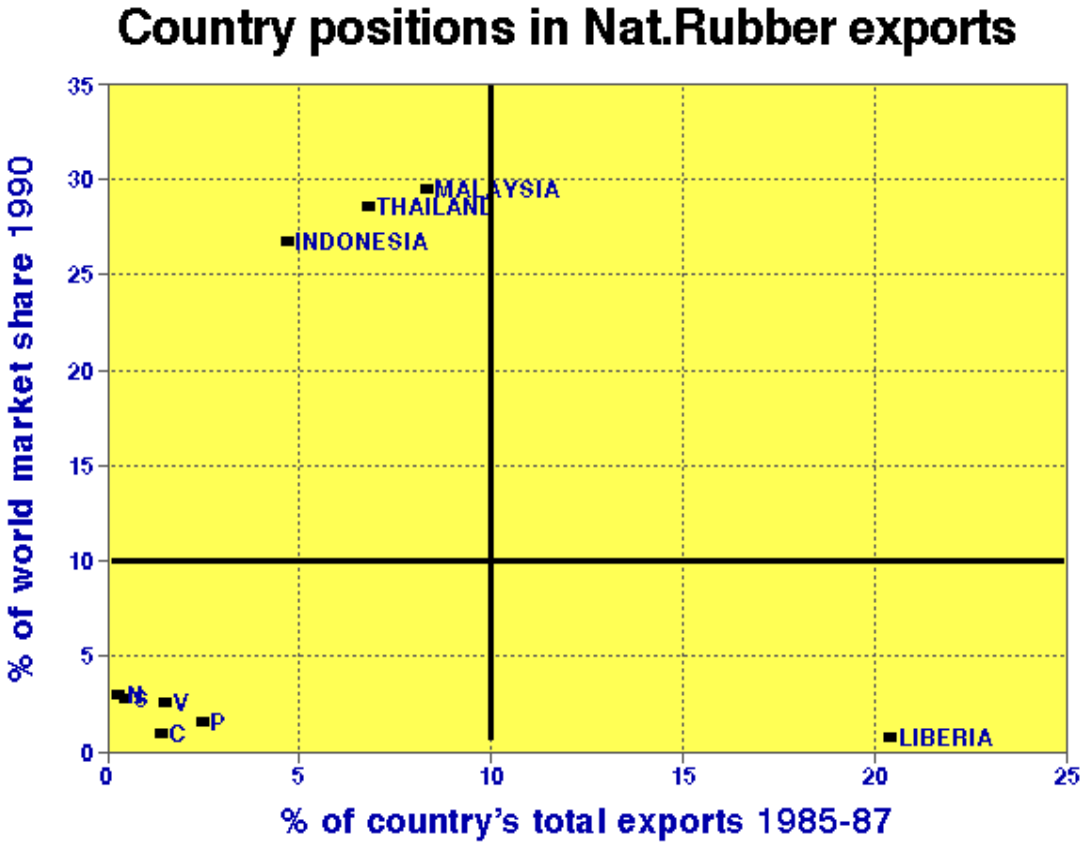
Consider the following case for international intervention (graph below). A purely domestic policy approach would maximize only net domestic social benefits of internalization measures. The purely domestic net benefits are those enclosed by the **green area** in the graph. Note that the international community gains as well (**yellow area**). This *could* be a ground for sharing the costs of the policy. Otherwise, the international community rides free on the positive effects of purely domestic policy. It is clear from the graph that the international community gains additional environmental benefits if compensation payments **(blue triangle)** are paid to the country for applying a tighter environmental policy than required on strictly domestic considerations.



Internalization and export commodities

For an export commodity, internalization should weigh against each other: the environmental costs and the social benefits of foreign exchange earned by the commodity export sector. These issues are captured in the following decision model.

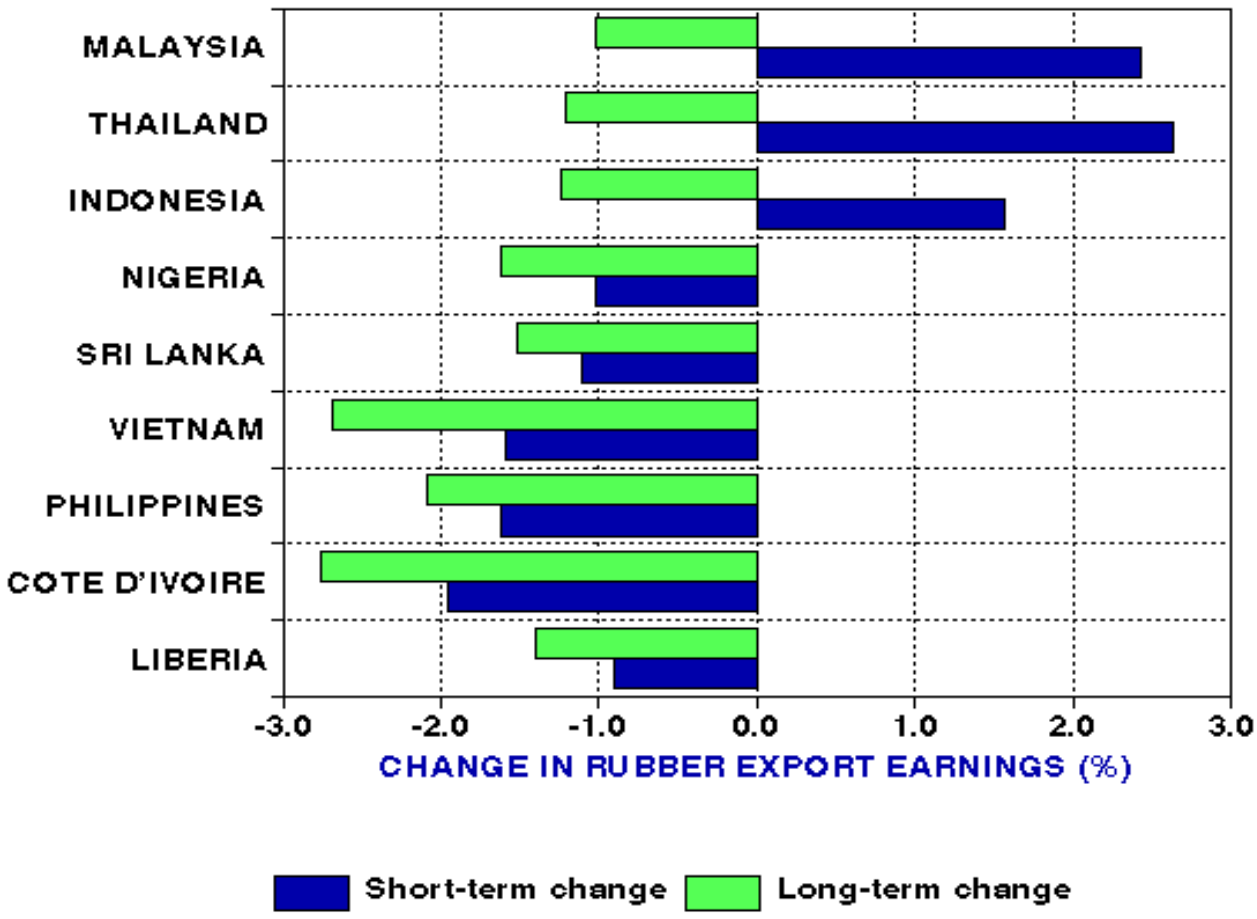
Export commodities: decision model for internalization policy. The model is now applied to country positions in the export of natural rubber. The graph below plots country positions of the main countries with net exports of natural rubber.



- Malaysia, Indonesia and Thailand have substantial market power in the international rubber market. Their internalization policy can be expected to affect world market prices. Because NR at the same time represents a rather small percentage of their total exports, they have the largest degree of freedom in implementing environmental policies *vis-à-vis* their rubber export sectors.
- For the smaller export countries (like Sri Lanka, Côte d'Ivoire, Vietnam, Philippines and Nigeria) domestic internalization policy will have little impact on international prices, but since NR exports are a small export product for them, no internalization policy will have a large effect on their total export earnings.
- Finally, Liberia is in the most vulnerable position (even apart from its civil war), because if environmental policy affects their rubber exports, it has a very substantial impact on their total exports.

Effect of internalization policy on export earnings.

To get a better perspective on the national policy margins in the context of international competition in the NR market, a simulation study was done, using empirical econometric estimates of the price elasticity of domestic supply and international demand for NR. The simulation assumed, for each of the main net export countries, that domestic environmental policy (*eg* an environmental tax) would result in a 10 per cent increase in cost price for NR producers. For each country it was assumed that it would be the only country that applied such measure, in order to get a 'worst case' scenario. Here are the results:



Conclusions from simulation study

- **Overall**, expected effects on country export earnings are quite small. The largest effects occur in countries with small international market shares where supply is price elastic. Even in the worst case, rubber export earnings diminish less than 3 per cent. In the short term, the **three large exporters** would even ***gain*** from levying the environmental tax. The gains are caused by the output-reducing and price-rising effect of the tax.
- The international market is hardly a constraint for applying domestic environmental policies in primary rubber production sectors. One may conclude from this that countries have ample opportunities to apply domestic environmental policies in the rubber sector without disastrous effects on export earnings.

Environment externalities in rubber latex production

Positive environmental effects are:

- In the humid tropics, perennial crops have clear advantages over annual crops: trees **regulate local micro-climate**, **preserve soils against erosion** and drying.
- A mature *Hevea* forest has a **closed nutrient cycle**. In North India it appeared that the quality of soils that were exhausted by prior slash-and-burn agriculture considerably improved after conversion to a *Hevea* plantation.
- A forest with 33-year old *Hevea* trees produces 450 tonnes/ha/y of **biomass**, which compares well with 475–660 tonnes/ha/y in Malaysian rainforests and 300–475 tonnes/ha/y in Brazilian and Thai rainforests.
- *Hevea* plantations have a considerable **carbon sequestration** capacity: approximately 11.5 tonnes/ha/y. Through this effect, *Hevea* forests generate positive international environmental externalities by contributing to prevention of global warming.
- A further positive international environmental externality is generated because the *Hevea* forests offer a habitat for a large variety of insects and animals, thus contributing to **biodiversity** preservation.
- After uprooting, the **wood** of the *Hevea* trees is useful for furniture production.

Negative externalities arise or may arise from:

- **Destruction of primary forest** for planting *Hevea* trees, temporary loss of habitats and local biodiversity.
- In the early stages of the plantation, **erosion through rainfall and leaching** (avoidable by adequate cultivation methods *eg* dikes, ditches, intercropping, shadow trees, shrubs and plants for ground cover and *N*-fixing). For smallholders, this may require extension activity.
- High-yielding *Hevea* varieties require **application of chemical fertilisers and fungicides** (avoidable by proper cultivation methods, like removing stumps of old trees, sufficiently diverse soil-covering plants, drainage in areas with high water level). Extension activity is important.

Summarizing:

- Primary production of latex causes **few negative** and **many positive** ecological effects.
- Negative externalities **can for the most part be avoided** by proper cultivation methods.
- The net positive environmental effects **accrue** primarily to the **producing countries,** but in part also accrue to the **international community**.
- Export earnings hardly form a constraint for environmental policy in NR export sectors. So, most countries have large policy margins for applying the necessary environmental legislation, plus 'carrots and sticks'.
- The positive international externalities created by *Hevea* forests can be a valid motive for **international assistance** in the form of **technology transfer** and **financial assistance** for sustainable production of primary natural rubber of sufficiently high quality.
- International assistance could even be warranted for (re)conversion of areas which are currently under other crops to *Hevea* forests, because of the latter's positive environmental effects on global carbon sequestration and biodiversity.
- Current predictions of new international price surges[1] for NR create a favourable policy environment for applying national and international internalization policies to further improve the sustainability of NR production.

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Mrs J Lalithambika, *Secretary-General, Association of Natural Rubber Producing Countries, Kuala Lumpur*

This is very laudable project and from the producers' point of view, we welcome it very much, although I have some anxiety regarding the implementation. The Project's objectives to incorporate certain cost elements in the price of rubber and thereby share those costs with all the parties in the NR industry, including manufacturers and of course, the final consumer, that are presently being largely borne by the producers would indeed be supported by producers. There are technologies presently available which could make the production of NR more eco-friendly. For instance, we can plant rubber on hill-slopes with minimal terracing and thereby minimize erosion. We can use organic fertiliser instead of chemical fertiliser. We can employ processing methods which would minimize or completely eliminate the harmful effects of effluents and so forth but, of course, there is a cost involved.

Having said that, let us look at the opportunities and constraints. What is the purpose of having noble objectives if they are not feasible? The UNCTAD paper looks at some of these. The government could intervene and promote eco-friendly methods of production. Financial and technical assistance could be provided to promote the same. There is, of course, the genuine problem of identifying producers who adopt eco-friendly methods in a country. When it comes to dealing with different countries, this problem would be quite complicated. More importantly, the role and the policy of the government in instituting regulations within a free market economy framework, effective steps for strict adherence to the regulations, a

country's technological competence and also the position of the economy are issues deserving serious consideration.

As I see it, one of the best ways is to educate the public on products made through eco-friendly production methods, particularly where synthetic substitutes are available as in the case of NR. Consumers' preference for products made through eco-friendly methods would translate into higher demand for these products *vis-à-vis* others, thereby contributing to high prices, subject of course to the supply position. We have to label such products. If the whole world adopts eco-friendly methods of producing NR, these costs would be reflected in prices. But how far it is practicable is yet to be seen.

What I would suggest is to educate the public not only on eco-friendly products but also intensify R&D to find more eco-friendly and cost-saving methods of production. Even the by-products or effluents could be utilised to produce valuable products. The bottom line is still cost and therefore if the margin between products made through eco-friendly methods of production *vis-à-vis* other means are relatively small, then I would think the consumers would go for these products.

In spite of the misgiving on the practicability of the project, I would support strongly the proposal of UNCTAD/IRSG to have a round table as it would provide a forum to focus on this problem. Relevant literature could be assembled and it could retain the interest of people in the importance of going for eco-friendly methods of production.

Dr Wan Abdul Rahaman, *Assistant Director, Rubber Research Institute of Malaysia, Kuala Lumpur.*

There is no question that the issue of the environment is gaining interest in both developed and developing countries. This is also reflected in some of the papers presented at the International Rubber Forum. This Workshop is therefore timely and offers a forum for initiating the platform for further discussion on rubber and the environment – and the internalization of environmental costs.

In addition, the interest in ISO 14000 by certain sectors would also further enhance the adoption of environment-friendly processes along the life-cycle path of a commodity or products. In my opinion, there is no question that just like ISO 9000, ISO 14000 would also be a requirement in production processes in the near future.

Judging from these developments, it is imperative that the rubber industry take stock of the 'implication' of the industry to the environment. In this context, the path of the 'life-cycle' of the rubber right from the production of the materials to the disposal of the resulting product at the end of the cycle would require environmental auditing, and this can be translated into cost.

At the production level, it will be useful if we can come up with a comparison of the 'environmental audit' and costing for all types and sources of rubber. Fair costing comparisons must be made in the context of renewable and non-renewable resources/or starting raw materials. Fair costing means comparing apples with apples – in this case if we

insist on sustainable agriculture development for NR production, we must also insist on sustainable industrial development in the case of SR production, and the costing be made on this basis and internalized.

Environmental cost auditing and the production level must also take into consideration the secondary effects, be they positive or negative effects – consider for instance the positive effect of about 90 million tonnes of CO_2 being fixed by 9 million hectares of rubber world-wide. The cost-benefit from this positive effect should be appreciated by all those concerned with greenhouse gases.

Similarly, the cost of adopting technologies for reducing soil erosion in order to qualify for the sustainable agriculture development label must be considered: this is an example of a negative effect.

On the NR production side, some of the environmental issues raised include processes in the following operations:

- burning during land preparation (problems of oil pollution, nutrient loss in N, PO_4, K and organic C);
- ploughing and harrowing during land preparation (problems of disturbance to soil structure and moisture depletion);
- use of agricultural chemicals (problems of air and water pollution);
- chemical fertilizers (problems of ground water pollution);
- storage of filled rubber material (problems of air and water pollution);
- clearing and processing (problems of malodour from sheet and block rubber, effluents from washing water, serum and uncoagulated latex).

The main issue in all the effort to internalize the environmental cost is 'who is to bear the cost?'. Will this burden the producers – just like the issue of wooden pallets?

These questions must be answered and it appears to me that the proposed sectoral round table will be the right platform to address these issues.

Mr I K Yeboah, *Chairman, Professional Association of Natural Rubber in Africa*.

This initiative by UNCTAD conforms with its mission of promoting trade of commodities, but it has now to conform to market requirements. The market is ruled by supply and demand. However, policies have been initiated in order to moderate these market forces. For example, we have the various commodity agreements as conceived by the Integrated Programme for Commodities elaborated since 1964. Most of these commodity agreements have not proved successful; either they were suspended or their economic provisions had to be abandoned, being reduced to research and development or indirect market stabilization. Some of them could not even pretend to have economic provisions because of the nature of the product (tropical timber, sugar, cotton, jute).

Out of the existing commodity agreement, only the International Natural Rubber Agreement (INRA) contains economic provisions. The cocoa agreement is now reduced to actions from the producing countries only at the production level, to regulate their output on the world market. The situation is the same for the coffee agreement.

Some of the major actors like the USA are no longer interested in commodity agreements. Since we do not attend UNCTAD meetings or follow all its activities we are inclined to ask if this Organization has ever tried to find out the reasons for the failure or the very limited success of commodity agreements.

UNCTAD is now taking upon itself environmental problems. This is something which appears, for the time being, as a fashion mainly in the northern countries, with the emergence of lobby groups in each of these countries. The Carthagena Conference has made a great echo everywhere. Countries are now insisting on including some of its objectives in the preamble of commodity agreements of the present generation (like INRA III). In Geneva, during the negotiation of the new INRA, participants spent time trying to understand the words 'Carthagena spirit' before its inclusion in the preamble. Under this circumstance there is a need to be careful in the internalization of environmental costs into the price of international commodities. What are these environmental costs to be included in the price of a product which is traded on the world market, which by definition is a competitive and free market? For example, what is 'sustainable management of rubber plantations'? Why should its costs be internalized into the price of rubber produced? Of course, being representative of producing countries, we must be satisfied with any increase or improvement in the price of our product, but we do not like to carry along any hopes that can easily lead to disappointment. Maybe this is because they are not yet consolidated enough, or they are built on parameters that are still difficult to control whereas the reality involved is concrete and true.

We have been interested in a programme presented recently on the TV showing patients in Canada suffering from 'environmental hypersensitivity'. This refers to diseases like allergy to air mixed with various chemicals. Some of these patients were compelled to wear masks or some kind of protection to go out. It is necessary that we do not wait until such a stage before we react against environmental problems; but should our reaction take the form of the cost involved to be internalized into the price of a product? How is this gain, this added value, going to benefit the concerned people, region, area or individuals who would have contributed in paying the cost. This example is an extreme situation. But we can see that the commodity whose price is to integrate environmental cost does not work as a medicine to relieve a patient.

This example shows only the correlation between the added value – the new cost as integrated in the price of the commodity – and its effect to solve the environmental problem concerned. For example, by paying additional cents to be incorporated into the price of rubber in order to sustain management of rubber plantations, is the customer guaranteed that this money will effectively serve this goal? Does he have any guarantee that he will not face a shortage of rubber? Not all customers are prepared to pay additional costs only for environmental purposes. The product must be useful or necessary to the customer, so that he is prepared or compelled to buy it.

It will be interesting to know why natural rubber and cocoa have proved successful to internalize environmental cost into their prices. Natural rubber is useful, unavoidable for some uses. The same goes for cocoa with regard to chocolate, but mainly cosmetics. This usefulness or need may be the basic reason for internalizing environmental cost into the price of some commodities. How is this internalization to be conducted? What is the market awareness of the damage caused by the environment as to include its cost into the price of the product concerned? Is internalization enough to guarantee the acceptability of the product?

In other words, if the new price is not acceptable (because it is too high) we may experience the reverse situation where people (the market) will leave this product for a substitute that may be cheaper.

Open discussion

Mr M E Cain. We have had a number of interesting contributions and we can already draw one or two conclusions. The first is that the environmentally friendly nature of natural rubber as a renewable resource is not in dispute. The second point is that it seems generally welcomed by members of the panel, at least, that we should have a discussion such as this at the International Rubber Forum where these issues can be explored. We have made some sort of definite statement on these two points already.

But in looking at the briefing paper, we come to the statement that UNCTAD believe that there is sufficient reason to explore fully the possibility of internalization in the case of rubber. Dr Kox has made some reference to the reasons for choosing natural rubber because 75% of its supply comes from only three producers and also because for each of these producers, rubber contributes only a small proportion of their export earnings. There are of course other reasons given, namely that it shares a major market with synthetic rubber, and that it is unlikely that synthetic rubber would replace natural rubber completely in that market if the cost structure were changed. This is the area that I would like the Panel to concentrate on first: what is the real evidence that this internalization process can be undertaken successfully either by one of these countries acting alone, or all three of them together?

We heard the suggestion that though they would benefit initially, there will be long-term costs and, of course, the small producers were shown to be disadvantaged right from the beginning. We have had discussions about the importance of the small producers, as well as the need for encouraging other countries to develop their rubber industries, because of the fears of the sustainability of rubber supplies in line with the increases in demand which are foreseen. This demand-supply situation was also thought likely to lead to changes in the cost structure.

Another aspect considered was whether, and at what level, the price of natural rubber would initiate research and development into synthetic rubbers to be translated into the production of synthetic polyisoprene, or the extent of the switch of existing formulations from natural to synthetic rubber.

I suggest that before we go on to identify what the constraints are, we ought perhaps to try and put ourselves on the firm basis that the statement by UNCTAD is, in fact, a valid one. I would like to ask the members of the Panel if they have any particular points to make on this. Perhaps Mr Kox is the one I am putting on the spot since he carried out the investigation, so if you can reply very briefly we can involve the other members.

Dr H Kox. Any reference to supply of natural rubber was from a broad viewpoint, and the exact conditions will differ considerably between countries. Countries with environmental policies will have to look at the benefits to their own country, and will have to make a trade-off – between a better environment *versus* gainful employment or export earnings, for example. This choice has to be made locally, and it will differ between countries and perhaps

this is the first factor that needs to be assessed. Internalization, therefore, may take different forms in different countries: in one country it may be a zero burning policy, in another it may be the expansion of extension services to assist smallholders in applying more environmentally sustainable ways of dealing with initial planting, avoiding soil erosion at that initial stage. As regards the primary processing of latex sheets, conditions will differ between countries, and countries will differ in vulnerability of surface waters for the effluent from these processes. Countries may take different policies to weigh the environmental benefits against the other issues at stake in the country like employment, income and export earnings. The general picture I got from the rubber sector is that in most countries, at least, export earnings will not suffer considerably from applying a domestic environmental policy.

Mr M E Cain. I wonder if Dr Hoffman has any comments. I am trying in fact not to say that different countries will identify different areas. I am asking what is the evidence there to believe that you could do this on such a scale, and whether countries are prepared to accept the reduction in earnings? In particular, have we looked carefully enough at what effect the cost or price increase for natural rubber will have on the balance of the natural/synthetic rubber share of the market?

Dr U Hoffmann. Let me put it this way. I agree entirely with Dr Kox that as far as internalization is concerned there are a thousand ways to skin a cat. However, overall, natural rubber is, by its very nature, a pretty environmentally sound product, which is not too frequent an occurrence in the world of goods and services. Secondly, you have a production process which can even be made more environmentally friendly if you use certain production methods, so you can increase, or rather enhance, the environment friendliness, in addition to the fact that the product *per se* is pretty environmentally sound. However, I think it would be a mistake to confine the entire discussion of internalization to the confrontation between natural and synthetic rubber. All or most of you know that to meet certain product specifications, it will be necessary or imperative to have a certain mix of elastomers. However, as we learnt from Dr Smit, it is ultimately a question of prices, and this is the point of the exercise, that some of the prices do not seem to reflect environmental factors, or don't seem to provide the right incentives.

That gets me back to yesterday's presentation. We have a situation that global rubber demand or total elastomer demand is forecast to increase considerably in the long term, but we have a problem with one of the two products. In the three key producing countries (and once again it is a very rare situation, when you have such a degree of concentration in any of the commodities), the relative productivity or profitability of the product in the context of the economy, I want to emphasize, is declining. This in fact is of great concern, as Dr Smit outlined yesterday. Let me also remind you that we have the trend in South-east Asia that these three countries are no more just major natural rubber producers but are increasingly becoming the key consumers, the key manufacturers of rubber products, and if I may say so the ball to a certain extent is in their own corner. To rectify this is what gets me back to my question about determining priorities. So what is the value accorded by a government, such as that in Malaysia, Indonesia or Thailand, to these values or services provided? Let us bear in mind in this regard that, as Dr Rahaman and Dr Kox emphasized, there is an international dimension. That is that rubber trees are rendering services which very closely resemble the services rendered by the tropical rain forest. This carbon sink function is, as I outlined in my presentation, is likely to be acknowledged – in monetary terms – by developed consuming countries. So there can be actual financial flows in recognition of this very fact.

Quite honestly, I have no uniform piece of advice in answer to the question. I can only say take a look at the situation, the situation is comparable to the one that agriculture suffers or enjoys in the context of the European Union. There are two options. One is to diversify into crop production which is pretty productive and profitable, but might not be environmentally desirable. The other option is to provide financial incentives such as subsidies, and penalise others. The fact of the matter is that increasingly in Europe, agriculture is recognised as rendering services not only for tourists. What I suggest is to narrow the width of questions for a resource agenda, being very specific but at the same time bearing in mind that we have several issues along the product cycle.

Mr M E Cain. I am sure there are many people in the audience with strong feelings about some of the remarks just made. Mr Jones you have any comments to make?

Mr K Jones. I do have a comment, unfortunately it is somewhat a bleak one. One of the most memorable statistics I have heard in the past week is that Russia only consumes 16,000 tonnes of natural rubber. It does not foresee any increase in its natural rubber consumption over the next three years, although it foresees an increase in its synthetic rubber consumption, which is mainly in the form of synthetic polyisoprene. The reason that Russia can continue to use synthetic polyisoprene is that it does not use lead-free petrol in its cars as do many Western European countries. Now Western Europe and the USA have got rid of the lead in their petrol, because they regard that leaded petrol as a major form of environmental pollution, whereas Russia has gone on to produce this petrol and therefore can continue to produce polyisoprene. I think that the problem is very difficult, and I would agree with Dr Hoffmann that subsidies are certainly an area which need be explored. In Europe and North America we take subsidies for granted in terms of agriculture. In producing tropical material, subsidies have always been regarded as intolerable. I think that one has got to have new kind of thinking to this new sort of environment.

Dr W Rahaman. I think the main issue as far as the producers are concerned is to look at the current cost of production and consider what the cost of production would be after taking into consideration the internalization of the environmental factors. I think this is a very pertinent issue at this point, mainly because what I was trying to get at in my opening remarks was for consumers to appreciate the issue of the environment together with the producers, and appreciate also that the price has got to be shared together. In Malaysia, depending on the plantation agency, the average production cost is close to US$1/kg, and if you look at the situation and bring in all the other factors, one has got to be looking at whether we are going to continue producing or stop producing. I think this is the basic issue that has got to be addressed when we bring in the internalization of environmental factors. I strongly feel when looking at this that we need to look from country to country as has been mentioned, because of course of the cost of production between countries differs greatly. I believe that this will be the determining factor, whether one country can continue production of rubber if all these factors are taken into consideration.

Mrs J Lalithambika. As I said earlier, I would like to emphasize that the most important point is the cost. Just as Dr Rahaman as pointed out, first is the cost of production. Then if eco-friendly rubber, where costs have been internalized, is available from one country for US$2 and cheap rubber without internalized cost is available from another country, which rubber will the consumer prefer? Unless there is uniform policy, how far is it practicable is the point to be considered.

Session 3: Open discussion

Mr M Cain. We have had two interesting papers and interesting contributions from the Panel. I would like to throw the meeting open to the floor.

Mr A van Feggelen. I have listened to all the very interesting statements just made and I think everybody is right, particularly the producers who highlight the importance of the price: we cannot just unilaterally declare an increase in prices. On the other hand, I disagree with one point made: in my view you cannot say that each country should consider the environmental actions to be taken on its own. This is because the one thing which is never one country's business is global ecology, which is not bound to one country. So perhaps we are discussing this from the wrong angle. We should not look at it only from the side of production but should also perhaps consider a system similar to Value Added Tax (VAT) – to characterize products based on their environmental pluses and minuses. It is nice to produce a very nice ecological, friendly product, but if it means that you need to transport this five times around the world by plane, this is very negative. In this way you can identify the pluses or minuses. So if a product has the status of, for instance natural rubber, which adds to the world's ecology, then it would get minuses, but get pluses for the transport or for the use of materials or processes detrimental to the environment.

If you go along the line of also establishing an ISO 9000 norm, you would then have a norm for each product and the there can be real competition at the final product stage. This would also avoid the example just given about Russian polyisoprene – if you have a product in which the polyisoprene is used, regardless of what the country itself may say on environmental costs, once it is established that polyisoprene adds so much pollution to the world then it will incur minus points. In this way you can weigh the importance of a product. Natural rubber will automatically be regarded as a product for which people will pay a better price, because the final stage product will attract a lesser penalty.

I think if people would look at it in that way, starting from the final product and then calculate back as a kind of system of VAT, this could be better. It would also be independent of whether the producing country is actually taking measures to avoid pollution. If they do avoid it, then they get a deduction on that point. I would like to ask the panel to take this into consideration and see whether perhaps we could approach the question from the other side.

Dr H Kox. The first question Mr van Feggelen raised was whether or not environmental issues are a matter for national concern, or whether they are an international concern. He is of the strong opinion that they are an international matter. I have some reservations about this. I believe there are clearly some environmental issues which can be of a local issue, a local scope, while some may be of a national scope and some environmental issues clearly transcend national borders and become international issues. Using VAT to finance sustainable production, an international VAT, risks the problem of not being finely attuned to environmental issues of the country in which it is supposed to finance more sustainable production methods. I would suggest that VAT can indeed be a good financing device for national environmental policies, but not on an international scale, because national conditions differ too much.

In the international area, I would suggest that, for instance, with regard to the positive externality exerted by the production of natural rubber, some voluntary schemes could be set

up, perhaps in the form of an environmental fund attached to international rubber organizations. Countries in the northern part of the world, or the richer developing countries, could pledge funds for more environmentally sustainable production of natural rubber and for re-conversion of other crop areas to natural rubber plantations, given its positive international externalities. It is interesting that in the context of the recent international cocoa agreement, a step has been taken to set up an environment fund on a voluntary basis in which the importing countries as well as the producing countries can place funds. These will be used for improving the environmental record in the production of cocoa. Something similar to that may be possible in the case of natural rubber.

Mr I Yeboah. I find it difficult to see how such environmental costing factors can come into play because different geographical areas are involved in production. The situation in the Far East may not be the same as in Africa for instance, and we do not wish to have a situation where there could be discrimination against one region. A typical example is one we are now facing where African rubber is being discounted. I do not know how this is going to work: we all know and we appreciate the fact that rubber should be produced in a very environmental friendly atmosphere. Ultimately, however, I think it should be on an individual country basis, to make sure that production is in an environmental friendly atmosphere. I have my doubts whether the international community consumers or the end users should be asked to pay for this.

Mr A van Feggelen. I would like to make clear that while VAT sounds similar to a price increase, what I meant to say was that in this system we add and deduct points. This would mean that at the final product stage, say as a tyre, if it is made out of polyisoprene it ends up with a penalty of 20 whilst the natural rubber tyre would end up with a repayment of 5 or such. It is not that the customer is paying for it. The customer looks at two final products, and can make a choice. I accept that it is not something that you can do in one day or in one year, it has to be built up. But we now see that the final consumers are really aware of what they are buying: when they buy a bottle of water they want to read on it what is in it. Therefore if you make it clear that a product contains less desirable elements from an environmental viewpoint, they may well prefer to buy the clean product and pay a better price for it. The points system, the VAT, should not be a scheme which increases the price of the product but more something where you try to balance the effects of the raw materials used in the final product.

Mr G Cantalupo. I have a question, a request for clarification. It is difficult for me to understand the exact meaning of the phrase 'the internalization of environmental costs into the price of rubber'. In the second paragraph of the first page of the briefing paper we read that 'the world rubber economy has a number of environmental problems whose costs are not currently reflected in producer and international rubber goods prices'. These are as listed in the paper – sustainable management of rubber plantations, effluent problems of rubber processing, high energy consumption, *etc.* Does this mean that the price of natural rubber is currently built up without taking account of all these factors?

Dr U Hoffman. It is exactly as you suggest. The factors mentioned are not reflected in prices or rather as the paper says, 'are not – or only imperfectly' reflected in prices.

Mr M Kpolo. Perhaps we now need to bring in a few clarifications, and this goes in hand with the preceding question. I think it is necessary to attempt an identification of the environmental costs to be internalized; for example what exactly is the sustainable

management of rubber plantations? Does it include the failure or performance of the management of the plantations? And are we going to put this failure or performance into the price of a commodity which is marketed in the world market? It is through the identification of environmental costs that we can then see at what level we are going to address these issues. The briefing paper suggests that it has to be addressed at the producer level. It might be a tax within a country similar to the cess or tax which is now implemented for research and/or replanting, but this would also affect the world market. It appears that we are now attempting to include in the price of the commodity something which is not really in line with demand and supply which governs the world market for any good. Therefore I cannot clearly see the objective behind this exercise.

Someone referred recently to the projected increase in the price of natural rubber. However, if there is an increase in the price, the cost of all these environmental issues need not be included in the price. Price is the result of demand and supply and dictates the market conditions. Before we move into actions where we cannot monitor the consequences, I would like UNCTAD to brief us on the main objectives. There was a reference to a fund for cocoa to deal with the environmental issues regarding cocoa – if the international community is prepared to do this for rubber it could be done. But this does not mean it has to be included in the market price, that is different. You may have a lot of money as a consuming or producing country and you can put this money into a fund, but we don't put environmental costs in the price of a commodity.

Dr U Hoffman. I shall probably answer your question by referring to an example which illustrates the objectives you were so concerned about. Take the example of the carbon sink function of a natural rubber tree or natural rubber forest. Today this is not reflected in the price; not in the producer price, nor as a producer cost, and nor is it reflected in any of the manufactured rubber goods price. Therefore it is not recognised in any way by the consumer. Yet it is, and all of us would agree, it is a great service. So let us put this issue into the context of the equation which Dr Smit drew up yesterday. According to Dr Smit's scenario, what we would have is that a natural rubber producer would move out of rubber production, at least in the three dominating producing countries, in the light of the fact that its production is no longer as profitable as the average of its economy as a whole. It could diversify out of rubber into some other activity – for example, flowers. You will agree with me that flowers have a very questionable environmental value although they might be brilliant for the eyes. So the fact of the matter is, and there I agree with you completely, internalization does not necessarily have to be reflected in the price of the producer. What you would do is, for example, that the country, or the international community or several countries, who appreciate that the carbon sink function of this producer is a service the producer renders, can provide a financial incentive. They would give the producer, for example, in Thailand, a kind of grant. The producer in Thailand otherwise would have to borrow from a bank or from a loan source, the same amount of money or less but at very different terms and such credit terms can be very restricting, as you know. In such a case, the money now coming would be regarded as a price for a function, or rather a benefit that is rendered by the producer of natural rubber. It increases the profitability of natural rubber production. This is a new variable introduced into the equation Dr Smit drew up yesterday.

I can assure you that I am familiar with the negotiations which are now underway in the run-up to the next Conference of the Parties of the Climate Convention. There is a lot of money involved and this money can be partly of use here, so it is a very pragmatic example. But you are right, it might not necessarily be reflected in producer prices so the producer prices can

remain unchanged, but the producer would get a kind of incentive and therefore it would dramatically lower his production costs and increase his profit margin, providing a greater incentive to stay in production, as compared to normal market rules. I hope I have made myself clear.

Dr H Kox. The last question seemed to suppose that supply and demand could ultimately take care of the internalization of all environmental issues. The problem is that it may be too late for it to happen. Certain market parties which should be present in the case of internalization, clearly are not. Future generations are not currently involved in supply and demand decisions but present production decisions may well influence the future. For instance, if by wrong cultivation methods, there is a high degree of soil erosion in the early stage of the rubber plantation, the soil is lost and it cannot be easily be recovered for the next generation. We have to cope with this type of market failure, and that is basically why we need some form of intervention of governments and perhaps international bodies, to make up for such market failure.

Mr M Kpolo. I would like just a few clarifications. As far as any environmental issues are concerned these might also apply for any commodity, whether in consuming countries or in producing countries. For example, as apples are produced here in Europe, you could also include the cost of environmental issues in the price of your apples. My view is that the discussion should try to make the distinction between the price as included in the market price and any fund which could provide support for environmental issues. If this clarification is to be accepted, it needs to be brought into the discussion. It is not because it is rubber, cocoa or timber but because these environmental issues need special consideration.

Mr Y Roland. I think a very important question is on the agenda, this question of the environment. Since the Rio Convention, we have considered the environment globally across all types of industries and activities, and I think we really should not be too pessimistic as far as environmental concerns for the production of natural rubber. There are two stages in the natural rubber production industry, first setting up the plantations, which can cause natural catastrophes, and then the manufacturing stage. In Côte d'Ivoire we have seen whole towns being polluted by rubber industries and this a very important factor to be taken on board. It affects the population which lives around these lagoons and today there is no way of saving these lakes and this is an environmental disaster and a great loss. So if we are speaking of the environment and putting rubber in the picture, then I think it is important. I think we have to subscribe to the spirit of the Rio Convention, and therefore need to take a global view to ensure that rubber production is environmentally friendly across the board.

Mr Durand. Just to take up the last point, I think along the same lines. There are certain general subjects that can be dealt with at an international level, issues such as the environment and the measures that have been taken to help the environment. However, as far as used scrap tyres are concerned, and this is a field that I know more about, you cannot immediately apply the same rules and laws in different states, because each state will have different volumes of scrap tyres; different ways of using these tyres or of warehousing them, *etc*. There are therefore two different types of issues. Some are those where we can be general and cover on an international level, and others where we will need to take a national approach.

Dr H Smit. I have great sympathy for the previous couple of speakers. I think it is very important to distinguish between national and international benefits and costs. I get the

impression that many bodies are concerned solely with the environment and try to capture anything possibly dealing with the environment, and put it all together to make the case stronger. I would say that many aspects of natural rubber production have costs. These may be manpower, or may also be health and safety measures, that should be put into the price which is paid by the consumer. I think the previous speakers were absolutely right in saying there will be a market price and that is it. I think therefore that we should be carefully distinguishing those costs which are really just production costs because there is no need to discuss including these into the price; they will come in automatically like wages, health and safety or others. If a producer cannot afford it anymore he should go out of the market. On the other hand, as Mr Roland said, if there is a disaster or if the scope is international then indeed we should do something about it, but in which way it should be done I am absolutely unclear.

Dr U Hoffman. I venture to disagree with your statement. Having been involved very closely in the discussions in the Basle Convention on Trade in Hazardous Waste, I can assure you that governments have taken very drastic action, contrary to the advice you just gave. They introduced actual health and environmental costs in the cost equation. I would just like to underline that it has already been done, though not by all parties. However, it is not even a precedent since some other conventions have done that before.

Mr J Thomas. I think the answer is simple. If the initiative comes from the consuming industry, if they are willing to pay a premium for the eco-friendly processed rubber, naturally producers will slowly go into eco-friendly rubber, realising its importance and relevance. It would be similar to what happened in tea, where there is organic tea produced with organic fertilisers in organic conditions for which buyers are willing to give a premium. So Indian and other producers of tea are going into organic tea. The initiative therefore should come from the consuming industry.

Mr M E Cain. The intervention from Mr Thomas does raise a question in my mind. We know of course that India is a natural rubber producer and a synthetic rubber producer, but it also imports natural rubber, and we heard a couple of days ago that its imports of natural rubber are expected to increase quite considerably. Can either Dr Hoffman or Dr Kox explain to me how the internalization of prices is in fact going to reflect on a country like India or one of the other net importers which has its own rubber production and industry but is nevertheless a significant importer. What is the incentive to make India produce rubber in an ecologically sustainable manner.

Dr H Kox. For India as a producer, the production of natural rubber affects its own domestic environment so if they wish to preserve it against higher production or applying cheaper production methods which are not environmentally sustainable, for example, this can be considered as a national trade-off. To the extent that the country is becoming a large consumer and a net importer, here we get to the question which Dr Smit touched upon yesterday when he was predicting that for commercial reasons only, there is an upcoming shortage of natural rubber supply in the future. We have also noted here in several contributions, that from an environmental point of view, natural rubber production should be higher than it is now compared to many other tropical crops. With this in mind, therefore, we can say that production of natural rubber is too low compared to what it should be, and if the price of rubber increases to some extent to reflect this coming shortage and the shortage of rubber supply compared to what would be desirable environmentally, then I think this is where internalization comes in. These commercial supply shortages will be reflected in the

futures markets. I think the market will take care of that and capitalize on it. With regard to environmental issues, there may be an opportunity for international organizations, the International Rubber Study Group and similar organizations, to step in and raise some forms of promotion of the environmentally benign effects of rubber production.

If nothing else, I owe the Indians present an apology. I listed Malaysia and Sri Lanka as being very aware of the water pollution problems associated with natural rubber production and unfortunately I forgot to add India to this list as a country which is very aware of this. Clearly India, as a natural rubber producer, regards this as a competitive edge as do Malaysia and Sri Lanka. I think it would be interesting if all the producers present could state whether their countries have a particularly strong environmental policy.

Mr Ng Kok Tee. Dr Hoffman earlier referred to international co-operation, while I think it was Dr Kox who mentioned that natural rubber is quite unique in a sense, because in the three main producing countries rubber cultivation is rather small in terms of GDP, therefore they can afford to quit natural rubber if the prices are not right. In that context, since many have mentioned that one option might be through introducing a form of taxation or cess in terms of internalization of the environmental costs, I just wonder whether this can be done through the ANRPC. Since most of the producing countries are members of the ANRPC, and if they can introduce a standardized form of environmental tax on top of the fob or market price, this would mean that it would not affect domestic prices but international prices. This fund or this tax would be diverted through government sources and would be for the use of environmental improvements. This would be a form of international co-operation as discussed earlier. Secondly, since we have identified natural rubber as environmental friendly and also since the Rio Convention included much discussion on international financing of environmental projects, I wonder whether any international agencies can provide financial assistance to those NR producing countries. This could be either in terms of technological transfer or in terms of financial assistance in improving their environmental measures, or shall we say for certain measures that can improve their technological ability in this respect. Perhaps Dr Hoffman and the ANRPC could comment on these two aspects.

Mr M E Cain. I wonder if Mrs Lalithambika would like to comment on whether she would like to ask her governments to impose a tax on the production of rubber, reminiscent of the old rubber regulation scheme. I would like to remind delegates, however, that although the ANRPC includes most rubber producing countries, many others are not in the ANRPC at the moment.

Mrs Lalithambika. I can only say that it can seriously be considered if all the member governments are willing to do so. As you know, there are rubber producing countries which are not members of ANRPC but still ANRPC accounts for 85% of the total of rubber production. If all the member governments are prepared to consider it seriously, then it is worthy of consideration.

Mr M E Cain. I think this is a positive contribution to the discussion. I will ask Dr Hoffman to make a reply to the second question, then I will take another intervention from Dr Smit.

Dr U Hoffmann. One minor qualification on your question regarding taxes. It is not clear to me why you suggest a tax on natural rubber rather than a tax on its synthetic rubber competitor? Why tax natural rubber, which is more or less benign, unless you link it to unsustainable production activities? But that would not be served or addressed by a tax

across the board. Moving to your second question: as far as international financial mechanisms are concerned, I am afraid I have to tell you that it is virtually not the case. The only form of very specific co-operation in this regard, where specific financial mechanisms have been set out, concerns areas which can be summarized as global environmental problems. They concern first global warming, where there is a convention, second ozone depletion covered by the Montreal Protocol, and desertification. These three areas conceived as global problems are taken care of by the Global Environmental Facility (GEF) which is jointly administered by the World Bank, the United Nations Development Programme and the United Nations Environmental Programme. This global fund is linked to the World Bank mechanism and has funds of almost a billion US dollars at the moment. Only this year a memorandum of understanding was signed confining financing activities for technical assistance training *etc*, to these three global issues. There was a qualifier, however, for desertification and for deforestation or sustainable forest management issues – but only to the extent that they have an effect on these three core areas, and if so would be taken into consideration. Other than the GEF, there are a number of bilateral activities between donor countries and specific developing countries, but these are bilateral forms of co-operation which assume various forms.

Dr K Jones. Listening to Dr Hoffman, I immediately thought that natural rubber production clearly has a very strong influence on global warming, and one wonders whether this fund, which at the moment levies a tax against people who produce ozone depleting materials or marine pollution, could not be used as a source of funding for the 'good boys' of the world who produce natural rubber?

Mr M E Cain. I am sure that this something we can consider further down the line.

Dr H Smit. I have a comment after the intervention of Mr Ng Kok Tee, first indeed the point which was also picked up by Dr Hoffman, about why not SR? The other point which one must not overlook is that if you put a tax somewhere, it is not just translated into a price, there will be a redistribution of activities and the least efficient farmer will go out of business. That is a way of life: you don't just expect that if you put a levy somewhere that some other people, the consumer or the market, will pick it up.

Chairman's closing remarks

Mr M E Cain. I think we have had a very interesting and wide-ranging discussion on a topic which I was right to identify as one which would be of interest and importance to Member Governments and Forum participants at this IRSG meeting. Once again, I would like to thank UNCTAD for the way they responded to this invitation and I would also like to thank Dr Hoffman, Mr Jones, Mrs Lalithambika, Mr Yeboah, Dr Rahaman and Dr Kox who responded by agreeing to sit on the Panel.

I think if I have to summarize the Workshop, it certainly seems that everybody agrees that natural rubber is an eco-friendly material and also that we are all concerned that there should be some benefit for natural rubber in recognition of this fact. Whether this is done by benefiting natural rubber – or penalising synthetic rubber which is a very emotive issue in some areas – or whether it should be done by tapping the resources that have already been generated through the pollution of parts of the environment, is a question which requires

further debate. Obviously I will talk to UNCTAD about the results of this meeting: we will need to have further discussion on this and it may well be that this topic will feature more frequently in discussions at IRSG meetings, either in the Forum or perhaps in the form of discussions among our Member Governments. Once again I would like you to join me in thanking all the participants this afternoon and in doing that I would also like to express my thanks to you all for staying on and participating. Thank you very much.

List of attendees

Belgium

Mrs Fazilet Cinaralp *Secretary General*	BLIC
Mr George McDougall *Marketing Manager*	Flexsys N V/S A
Mr Peter Rowley OBE *Adviser*	BLIC

Cameroon

Chief Alex I Eboka *Group Rubber Manager*	Cameroon Development Corporation
Mr John B Fombe *Industrial Quality Manager (Rubber)*	Cameroon Development Corporation

Cote d'Ivoire

Mr Vincent Niagne Agnimel *Secretary General*	APROMAC
Mr D Mapri Kpolo *Executive Secretary*	Professional Association of NR in Africa
Mr Yves Roland *President Directeur General*	SAPH
Mr I K Yeboah *Chairman*	Professional Association of NR in Africa

Czech Republic

Mr Jan Byrtus *Director Div 4*	Chemapol Ltd

France

Mr Jean-Pierre Blondeau *Manager Europe/Africa*	Manufacture Michelin
Mr Hugues de Livonniere *Rubber Technologist*	CIRAD
Mr Marc Durand *Sous-Direction Materiaux*	Ministere de l'Industrie (SERIBE)
Mr Jean Hourseau *Departement, Industrie Statistique*	SNCP
Mr Charles Hubert *Senior Buyer*	Grace SA
Mr Jean-Noel Le Cardinal *Executive Board Member*	Safic-Alcan
Mr Philippe Monnin *Adjoint au Developpement*	Safic-Alcan
Mr Alain Tonning *Purchasing Manager*	Dunlop France

Germany

Mr Günter Lemke *Second Secretary*	German Embassy (UK)
Mr Wolfgang Noss *Department Manager Raw Material Buying*	SP Reifenwerke GmbH

Mr Horst Sakreida *Manager*	Kautschuk-Gesellschaft
Mr Ingomar Tietz *Referent*	Federal Ministry of Economics
Mr H-U von Tippelskirch *Corporate Purchasing Raw Materials Tires*	Continental AG
Mr Gerhard Wachholz *Market Research Manager*	Bayer AG
Dr Marco Weber *Mngr Corporate Purchasing Raw Materials Tire*	Continental AG
Mr Rene M Weber *Manager*	Weber & Schaer GmbH & Co

Hungary

Dr Istvan Soos *Research Director*	TAURUS Rubber Co Ltd

India

Mr K J Mathew, IAS *Chairman*	Rubber Board
Mr K Jacob Thomas *Managing Director*	Vaniampara Rubber Co Ltd

Indonesia

Dr A F S Budiman *Executive Director*	GAPKINDO
Mr Nogoseno *Director of Program*	Directorate General of Estates
Mr Ngurah Swajaya *Head, International Agricultural Commodities*	Department of Foreign Affairs

Italy

Mr Giuseppe Cantalupo *Marketing Services Manager*	EniChem SpA
Mr Giuseppe Locati *Director Corp Health & Environment*	Pirelli SpA
Mr Brian Moir *Senior Commodity Specialist*	Food and Agriculture Organization

Japan

Mr Goro Miyabe *General Manager*	Japan Synthetic Rubber Co Ltd
Mr Yosuke Miyamoto *Attache (Commerce)*	Embassy of Japan (UK)
Mr Moriaki Ohashi *Deputy General Manager, Gen. Admin. Dept.*	Japan Rubber Manufacturers Assn

Malaysia

Mr Arumugam *Senior Research Officer*	Assn of NR Producing Countries
Mr Baharuddin Bin Awang *Deputy Director General*	RISDA
Mr Sandana Dass *Managing Director*	Mardec Bhd

Dr Ong Eng Long *Assistant Director*	RRIM
Ms S K Gong *Executive Secretary*	International Rubber Association
Mr Mazlan Jamaluddin *Chairman*	Malaysian Rubber Producers' Council
Mr Ng Kok Tee *Deputy Chairman/Chief Executive Officer*	MRELB
Mrs J Lalithambika *Secretary General*	Association of NR Producing Countries
Mr Teo Lay Liang *General Manager*	Felda Rubber Industries Sdn Bhd
Tan Sri Lee Boon Chim *President*	Fed of Rubber Trade Associations
Mrs Norasmah Shamsudin *Principal Assistant Secretary*	Ministry of Primary Industries
Mr R Sharifuddin *Managing Director*	Felda Rubber Industries Sdn Bhd
Ms Teo Suat Cheng *Undersecretary, Rubber Industries Division*	Ministry of Primary Industries
Dr Habibah Suleiman *Head, Rubber Economics & Planning Unit*	MRRDBd
Dr Rahaman Wan Abdul *Assistant Director, Production R & D Department*	RRIM
Mr Mohammad M Yusoff *Counsellor (Commodities)*	Malaysian High Commission (UK)
Mr Ahmad Zubeir H Noordin *Executive Director*	International NR Organization

Netherlands

Ms Eltha L Brown *Assistant Project Manager*	Common Fund for Commodities
Mr H L M Kox *Researcher*	ESI/Free University, Amsterdam
Dr Hidde P Smit *Managing Director*	ESI/Free University, Amsterdam
Mr A A van Feggelen *Managing Director*	L Wurfbain & Co bv

Nigeria

Chief Bassey E O Edem *Vice Chairman & Managing Director*	Pamol (Nigeria) Limited
Mr Ayoola Fasina *Acting Director*	Rubber Research Institute of Nigeria
Mr Godswill E Ukpabio *Assistant Director*	Central Bank of Nigeria
Mr Innocent Uwaleme *Assistant Chief Commercial Officer*	Federal Min of Commerce & Tourism

Papua New Guinea

Mr V T Ratnam *Director, Rubber Industry*	Dept.of Agriculture and Livestock

Russian Federation

Mr V I Bakhtin *Adviser of Department*	Ministry for Foreign Economic Relations
Mr V M Egorov *Adviser of Department*	Ministry for Foreign Affairs
Mr V M Lozhkin *General Director*	JSK Geveya
Mr D I Sukhoparov *Head of Department*	Ministry for Foreign Economic Relations
Mr Konstantine V Trofimov *Deputy Trade Representative*	Embassy of Russian Federation (UK)

Singapore

Mr Patrick Hays *Managing Director*	SMPT Pte Ltd
Mr Tan Koh Young *Director*	International Connex Holdings Pte Ltd
Mr Sridhar Krishnan *Vice President*	Olam International Limited
Mr Huang Thiay Sherng *Group General Manager (Rubber Operation)*	Lee Rubber Group
Mr Lim Toh Eng *General Manager*	SICOM
Mr Jeffrey P H Wong *Managing Director*	Continental Tyre & Rubber (S) Pte Ltd

Sri Lanka

Mr R S Jayaratne *Secretary*	Mini of Public Admin Home Affairs
Mr Hussein I Rahim *Chairman*	A M Rahim & Co Ltd

Sweden

Mr Mikael Jonson *President Trelleborg Automotive*	Trelleborg Industri AB

Switzerland

Mr Ulrich Hoffmann *Economic Affairs Officer*	UNCTAD
Mr Paavo Lindholm *Chief, Market Dev Section-Manuf Products*	UNCTAD/WTO - International Trade Centre

Thailand

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Mr Promdej Sucharit *Consultant Rubber - Economic*	Rubber Research Institute of Thailand

United Kingdom

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Mr Adrian Brazier *Chemicals Directorate*	Department of Trade and Industry
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Mrs Susan Cain *European Office*	Int Institute SR Producers
Mr Roger Colnet *Managing Director*	Lewis & Peat (Rubber) Ltd
Mr Anthony J Dorken *Deputy Director*	British Rubber Manufacturers' Association Ltd
Mr Ian M Gardiner *Director of Policy*	NFU
Mr Philip D Gatland *Executive Director*	Tropical Growers Assn Ltd
Mr Brian W Hackwell *Consultant*	CMAI Europe
Mr Hubert Hallman *Financial and Administrative Officer*	International Lead and Zinc Study Group
Mr Steve Heuston *Partner*	S C Heuston & Co (Rubber) Ltd
Mr James Heyworth *Senior Rubber Trader*	Guthrie Symington Ltd
Mr John Hobbs *Executive Director and Secretary*	Association of the International Rubber Trade
Mr Gary Howe *Consultant - Plastic Materials*	RAPRA Technology Ltd
Mr Timothy J Hunt *Research Economist*	LMC International Ltd
Mr Kevin P Jones *Secretary*	IRRDB
Ms Kristina Lawson *Head, Information & Technical Communications*	Tun Abdul Razak Research Centre
Mr J P Lee *Director*	Guthrie Symington Ltd
Mr Peter L Mitchell *Proprietor*	ATHR & Co
Mr Richard O'Dell *Business Manager*	Enichem Elastomers Ltd
Mr David Odell *Manager, UK Crosstrades Division*	P & O Nedlloyd
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Mr Ashley Rosengarten *Chemicals Directorate*	Department of Trade and Industry
Mrs Barbara Seymour *Administrator*	Lewis & Peat (Rubber) Ltd
Mr Richard B Simpson *Technical Manager*	RAPRA Technology Ltd
Mrs Doreen Willers *Managing Director*	Hecht Heyworth & Alcan Ltd
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United States of America

Mrs Anita D Banks *International Economist*	Department of State
Mr William M Kendall *Observer*	American Embassy (UK)
Ms Julie Nutter *First Secretary, Economic*	American Embassy (UK)
Mr Brian Stabler *Inward Marketing Manager*	Hoegh Lines Agencies Inc
Mr Jack Trickett *President*	Envir0pak Inc
Mr Thomas F Will *Manager, Management Information*	Goodyear Tire and Rubber Company

Press

Mr Abdul Jalil Abdul Hamid *Correspondent*	Reuters Ltd
Mr James P L Dyson *News Editor, Commodities*	Dow Jones Newswires
Mr Gary Mead *Commodities Correspondent*	Financial Times