# Submission to SBI from WWF

**Proposed schemes to tackle greenhouse gas emissions from international maritime transport - potential impacts on developing countries**

WWF welcomes the opportunity to submit view on this topic. This submission is made to the SBI under Agenda Item 6 (a) – Progress on the implementation of decision 1/CP.10, in the context of the impacts of the implementation of response measures.

WWF has undertaken the research presented below as part of on-going activities to understand the impact of the implementation of response measures in the maritime sector, with the aim of promoting risk management approaches and other appropriate responses to the impact of the implementation of response measures.

---

Inclusion of maritime transport in a global climate policy could bring significant climate benefits. In order to reduce emissions, ship owners and operators will incur costs, which they will pass on to their clients. As a result, the cost of shipping will rise. This may have several impacts on developing countries, ranging from direct impacts such as higher costs of food imports to indirect impacts such as changed incentives for fragmentation of production. This report focuses on three potentially adverse impacts, viz. increasing costs of food imports, increasing costs of exports and tourism. These are discussed in Sections 1.1.1, 1.2 and 1.3 respectively. Section 1.4 focuses on the potential benefit of increased fleet turnover that may occur as ships with relatively high $CO_2$ emissions may become unviable.

## 1.1 Impacts on food import costs

Some countries are highly dependent on maritime transport for their food imports. Table  shows which countries have a high amount of food imports relative to their GDP. Islands in this table will import most of their food by sea (with the possible exception of perishables which may be imported by air).

Table 1 Food imports relative to GDP

| Country | Food import (% of GDP, 1999-2004) |
|---|---|
| Sao Tome and Principe | 28.02 |
| Mauritania | 24.36 |
| Gambia | 19.92 |
| Liberia | 19.30 |
| Guinea-Bissau | 18.96 |
| Sierra Leone | 17.82 |
| Cape Verde | 15.94 |
| Occupied Palestinian Territory | 14.77 |
| Bosnia and Herzegovina | 13.20 |
| Guyana | 13.16 |
| Tonga | 12.77 |
| Lesotho | 12.69 |

| | |
|---|---|
| Senegal | 12.65 |
| Eritrea | 11.63 |
| Dominica | 11.52 |
| Samoa | 11.23 |
| Estonia | 11.18 |
| Mongolia | 11.15 |
| Suriname | 10.99 |
| Saint Lucia | 10.95 |

Source: FAO statistical yearbook 2005-2006, Table C.13.

With the exception of Estonia, all countries listed in Table 1 are non Annex I countries.

For the islands in Table 1, emissions associated with food imports have been estimated bottom-up using FAO figures on food imports. Details of the estimates are in Appendix I. We find that for these islands, emissions associated with food imports range from 0.6 to 1.0 kilotonnes of $CO_2$ for Dominica, which mainly imports from the USA and from other Caribbean islands, to 7 to 11 kilotonnes for Cape Verde, which has the highest imports in terms of weight. In total, emissions associated with food imports in these islands are 18 to 29 kilotonnes of $CO_2$ per year. The increase in the costs of food imports is presented in Table 2 under various carbon prices.

Table 2 Increases in prices of imported food

| Country | Increase in costs of food imports (% of food import values) | | |
|---|---|---|---|
| | US$ 10/tonne of $CO_2$ | US$ 30/tonne of $CO_2$ | US$ 50/tonne of $CO_2$ |
| Sao Tome and Principe | 0.12-0.21% | 0.37-0.62% | 0.62-1.03% |
| Cape Verde | 0.06-0.10% | 0.18-0.30% | 0.30-0.50% |
| Tonga | 0.11-0.18% | 0.33-0.55% | 0.55-0.91% |
| Dominica | 0.04-0.06% | 0.11-0.18% | 0.18-0.30% |
| Samoa | 0.11-0.18% | 0.32-0.53% | 0.53-0.88% |
| Saint Lucia | 0.01-0.02% | 0.03-0.06% | 0.06-0.09% |

Source: See Appendix

As a share of GDP, increased costs of food imports range from around 0.03% for a carbon price of US$ 10 to up to 1.03% for a carbon price of US$ 50.

## 1.2 Impacts on exports

Some countries are more export oriented than others. As a result, a significant share of their GDP may be in export-oriented industries. A large share of exports is transported over sea, certainly if measured on a weight basis. Climate policies that increase the costs of maritime transport may result in lower demand for exports from these countries.

The impact of climate policies on transport prices depends on the instrument. Market-based instruments on $CO_2$ emissions (or fuel use) raise the fuel costs of transport, which typically constitute between 30 and 60% of the total costs (Resource Analysis and CE, 2008). Table 3 indicates the additional costs for burning one tonne of HFO under a range of carbon prices. At a fuel price of around US$ 700 per tonne (the level of July 2008)[1], a carbon price of US$ 30 per tonne of $CO_2$ would add 13% to fuel costs and 4-8% on total transport costs. At a fuel price of around US$ 450 per tonne (the price level of January 2008)[1], the same carbon price would add 6-12% to total transport costs.

Table 3 Impact of economic instruments on fuel costs

| $CO_2$ price, direct or implied (US$/tonne of $CO_2$) | Fuel price increase (US$ per tonne of HFO) |
|---|---|
| 10 | 31 |
| 30 | 93 |
| 50 | 156 |

Note: One tonne of HFO yields 3.1144 tonnes of $CO_2$ on combustion (MEPC/Circ.471).

The impact of these cost increases of maritime transport on exports is hard to assess. In the short term, they are unlikely to have an impact on the exports of manufactured goods, as the transport costs make up only a small fraction of the total costs and even if these costs are passed through in the prices, they are unlikely to affect demand significantly. UNCTAD (2007) estimates total freight costs (for all modes of transport) to be 5.9% of the value of imports; the share is lower in developed countries (4.8 %) and higher in developing countries (7.7%, ranging from 4.4% in America to 10% in Africa). It is not known what the maritime freight costs are relative to the value of imports. Higher transport costs may have a larger impact on exports of raw materials, as transport costs make up a larger proportion of the total costs. Nevertheless, there will only be an impact if alternatives are available or if demand is reduced. In the longer run, higher transport costs could affect decisions to relocate production, bringing production closer to markets or halting the current trend of fragmentation of production. However, it has to be noted that many factors affect the choice of production locations, including relative costs of inputs of labour and materials, access to markets, et cetera.

Based on the estimates above, an increase in transport costs between 4 and 8% and a share of transport costs in value of 4 to 10%, it can be estimated that the increase in costs of import is less than 1% on average.

As there are many other means to reduce transport apart from reducing exports (and even more ways to reduce emissions), the maximum impact of climate policies on profits would be the impact of higher costs on transport demand. This can be calculated by applying the price elasticity of demand to the cost increase.

There is only scarce information on price elasticity of maritime transport. Oum et al. (1990) present elasticities ranging from 0 to -1.1, with the low values (-0.06 to -0.25) typically for dry bulk for which there are hardly any alternative modes of transport, and the higher values (0 to -1.1) for general cargo. Meyrick and Associates et al. (2007) estimate the elasticity of non-bulk maritime transport to and from Australia at -0.23. Assuming an elasticity of -0.25, the 4-8% rise in transport costs could result in a

---

1 Quoted prices on www.bunkerworld.com for IFO380 in Rotterdam.

reduction in maritime transport of 1-2% relative to a baseline which is forecasted to grow at over 3% per year (MARINTEK et al., 2008). So the cost increase would result in sacrificing about half a year of growth. As mentioned above, the reduction in exports is likely to be lower than this reduction in transport, as a share of the transport reduction will result from logistics improvements and other measures to reduce emissions, such as slow steaming.

## 1.3 Impacts on tourism

For some states, a significant share of GDP is earned in the tourism sector, and many tourists arrive by ship. Table 4 shows that for some tourist destinations in the Caribbean, cruise passengers arrivals exceed arrivals by other means by up to a factor of ten. And although arrivals are a very crude approximation of economic value, it is clear that the tourism sectors in these countries and regions are focused on cruise passengers.

Table 4 Importance of cruise tourism - the Caribbean as an example

| Destination | Cruise Passenger Arrivals, including day visits (2005) | Total Arrivals of tourists who stay at least one night (2005) |
|---|---|---|
| Bahamas | 3,349,998 | 1,514,532 |
| Cozumel (Mexico) | 2,519,179 | 276,515 |
| US Virgin Islands | 1,912,539 | 697,033 |
| Cayman Islands | 1,798,999 | 167,801 |
| St Maarten | 1,488,461 | 467,861 |
| Puerto Rico | 1,315,079 | 1,449,785 |
| Jamaica | 1,135,843 | 1,478,663 |
| Belize | 800,331 | 236,573 |
| Barbados | 563,588 | 547,534 |
| Aruba | 552,819 | 732,514 |

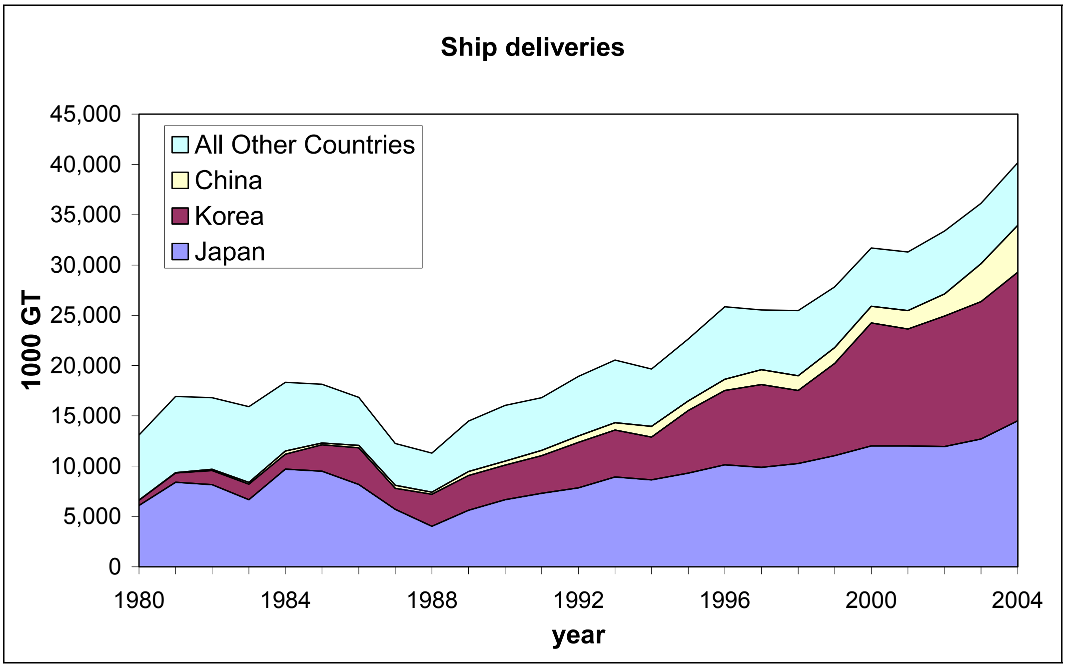
Source: Caribbean Tourism Organization.

Including maritime transport in a global climate policy regime could increase the costs of cruise travel and if this cost increase were to be passed through in prices, it could lower demand. This would not be primarily due to the own price elasticity of demand, as most studies find tourism demand to be price inelastic (price elasticities of -0.4 to -0.8, although there are notable exceptions) (Crouch, 1994). More important is the choice tourists face: cross-elasticities in tourism demand seem to be high (Maloney and Montes Rojas, 2005), implying that demand shifts easily from one destination to another. Cross-elasticities between modes of transport are not reported, but if these are as high as between destinations, one would expect a shift in demand to other modes of transport. However, these other modes also have emissions, and if these are also included in climate policy, relative prices of cruises are not expected to change much. The relative price of cruise holidays would only rise if maritime transport is included in climate policy, but aviation and car travel are not.

### 1.4 Impacts on shipbuilding

Including maritime transport in a climate policy is likely to result in a demand for ships with lower $CO_2$ emissions. This can be arrived at either by modifying existing ships or replacing them with new ships. As a consequence, including shipping is likely to have a positive effect on demand for shipyard services. As Figure 1 shows, most of the major shipyards are in Asia, and a significant number of them are in two non Annex I countries.

Figure 1 Korea, Japan and China are the major shipbuilding nations




Source: Lloyds register.

---

## References

**IPCC, 2007**
W.N. Adger, S. Agrawala, M.M.Q. Mirza, C. Conde, K. O'Brien, J. Pulhin, R. Pulwarty, B. Smit, K. Takahashi
Assessment of adaptation practices, options, constrains and capacity

**Crouch, 1994**
Geoffrey I. Crouch
Price Elasticities in International Tourism
In : Journal of Hospitality & Tourism Research, Vol. 17, No. 3, 27-39

**Maloney and Motes Rojas, 2005**
W. Maloney and G. Montes Rojas
How elastic are sea, sand and sun?
Dynamic panel estimates of the demand for tourism

In : Economic Letters 12, 277-280

**MARINTEK et al., 2008**
MARINTEK, CE Delft, Dalian Maritime University, Deutsches Zentrum für Luft- und Raumfahrt e.V., DNV, Energy and Environmental Research Associates, Lloyd's Register-Fairplay, Mokpo National Maritime University (MNMU), National Maritime Research Institute (Japan), Ocean Policy Research Foundation (OPRF)
Updated Study on Greenhouse Gas Emissions from Ships, phase 1 report
MARINTEK : Trondheim, 2008

**Meyrick and Associates et al., 2007**
Meyrick and Associates, GHD and Booz Allen Hamilton
International and Domestic Shipping and Ports Study, report to DTEI on behalf of the Australion Maritime Group (AMG)

**Oum et al., 1990**
Oum, T.H., W.G. Waters II, Y.S. Yong
A Survey of Recent Estimates of Price Elasticities of Demand for Transport, Worldbank Productivity Commission

**Resource Analysis and CE, 2008**
Analyse van de implicaties voor Vlaanderen van beleidsmaatregelen voor de internationale scheepvaart inzake klimaat en verzurende emissies (analysis of the impacts on Flandres of policy measures for international maritime transport in the fields of climate and acidifying emissions) Report to the Flemisch Admistration
Brussels/Delft : Resource Analysis/CE Delft, 2008

**Tol, 2002**
R.S.J. Tol
Estimates of the damage costs of climate change. Part 1 : benchmark estimates.
In : Environmental Resource Economics, 21, 47-73

**UNCTAD, 2007**
Review of Maritime Transport
New York/Geneva : UNCTAD, 2007

# ANNEX: Calculating the cost increase of food imports

Cost increases of food imports have been calculated using the following formula:

$$\Delta C_{Food\,\mathrm{Im}\,ports,i} = \frac{p_{CO2} \times \eta_{CO2} \times T_{Food\,\mathrm{Im}\,ports,i}}{C_{Food\,\mathrm{Im}\,ports,i}}$$

Where:

| | |
|---|---|
| $\Delta C_{FoodImports,i}$ | : The change in food import costs for country i expressed as a percentage of GDP |
| $pCO_2$ | : The prevailing price of $CO_2$ |
| $\eta CO_2$ – | : The $CO_2$ efficiency of food transport |
| TFoodImports,I | : The transport work (in tonne miles) of food imports in country i |
| CiFoodImports | : The value of foods imported in country i |

The transport work of food imports has been calculated as:

$$T_{Food\,\mathrm{Im}\,ports,i} = D_i \times Q_i$$

Where:

$D_i$ : The average distance between the largest port in i and the largest ports in its three main trading partners for food imports

Qi : The quantity of food imports in i (in tonnes)

**GDP (mln US$)**

The plain data was taken from FAO's database The Compendium of Food and Agriculture Indicators 2006.

Selecting a country from http://www.fao.org/statistics/compendium_2006/list.asp provides the factsheet on food and agriculture indicators of that country, for source year 2004. Sources of the factsheets are both FAOSTAT and the World Bank.

**Main Port**

The First source was the WordPortRanking2006. The largest port for countries (on the basis of total cargo volume in millions of tonnes) was looked up in this list. For countries not listed here, the largest port was looked up via http://www.worldportsource.com/countries.php (listing ports per country), on the basis of size (large, medium, small, very small) and type (wharf, jetty, seaport). If on the basis of these criteria proper selection was not possible, the largest port was found via a general internet search.

**Food Imports (million USD, 2004)**

The plain data was taken from FAO's database The Compendium of Food and Agriculture Indicators 2006.

Selecting a country from http://www.fao.org/statistics/compendium_2006/list.asp provides the factsheet on food and agriculture indicators of that country, for source year 2004. Sources of the factsheets are both FAOSTAT and the World Bank.

The subindicator 'Agricultural' of the indicator 'Foreign Trade – Imports' was assumed to represent the country's food import. However, this indicator refers to crop and livestock products only, i.e. fishery products are not included.

**Food Imports (1,000 tonnes, 2004)**

The data was derived from FAO's database The Compendium of Food and Agriculture Indicators 2006, as plain data on food import quantity was not available. Selecting a country from http://www.fao.org/statistics/compendium_2006/list.asp provides the factsheet on food and agriculture indicators of that country, for source year 2004. Sources of the factsheets are both FAOSTAT and the World Bank.

The indicator 'Imports' shows a list of 'Main Agricultural Products', both as quantity (1,000 tonnes) and as value (million USD). In addition, it provides a 'Total of Agricultural Products', as value only (million USD). The sum of 'Main Agricultural Products' does not equal the subindicator 'Total Agricultural Products'. There is a gap of 20 to 50% between the two (depending on country). Assuming the emphasis of food import to the islands is on bulk products/commodities[2], the ratio of 'Total of Agricultural Products' over 'Main Agricultural Products' is expected to be approximately the same for value and quantity. Therefore, the indicator 'Food Imports (1,000 tonnes)' was derived by applying this ratio to the sum of 'Main Agricultural Products'.

**Main Trading Partners**

Plain data, both on trading partners and on traded quantities, was taken from FAO's statistics database FAOSTAT http://faostat.fao.org/site/537/default.aspx, for the most recent data year available. The latter varies per country and per commodity.

**Distance to Trading Partners (nautical miles)**

Within the scope of this project, it was not feasible to research in detail the trading routes between the countries examined. Therefore, we made the assumption that all trading routes are from main port of exporting country to main port of importing country. In some cases, the route to/from the main port implies a major detour, and may therefore not to be the most realistic route. For this reason, we give some additional distances to/from large ports other than the main ports.

For finding distances between ports, the website
http://www.portworld.com/map/?gsid=b89826df0ddfc1595be5808aface0854&asi=1
was primarily used. For ports not available from this website, a neighbouring port was considered instead. For the ports in question this was a safe assumption, as the distance to the neighbouring port was marginal. Neighbouring ports were found via a general internet search.

In addition, http://gc.kls2.com/ which is in fact a website on *flight* distances, was used to crosscheck some distances (only possible for straight line sea routing).

**The $CO_2$ efficiency of food transport**

The $CO_2$ efficiency of food transport is assumed to be the $CO_2$ efficiency of general cargo ships, which according to MARINTEK et al. (2008) is between 11.9 g $CO_2$/tonne km and 19.8 g $CO_2$/tonne km (or 6.4 g $CO_2$/tonne nm and 10.7 g $CO_2$/tonne nm)

---

2 Commodities import (i.e. a mix of flour, meat, beverages, etc) typically represent relatively low value per unit weight, as opposed to specialties (i.e. herbs, etc) which typically have a relatively high value per unit weight.